MARINE REVIEW

WEEKLY.] AND MARINE RECORD. [ESTABLISHED, 1878.

Vol. XXVI | Published every Thursday at 39-41 Wade Bldg by the Marine Review Pub. Co. | CLEVELAND, O., DEC. 18, 1902. Eastern Office, 1023 Maritime Bldg., New York City Chicago Office, 373 Dearborn St. [Entered at Cleveland Post Office as second-class matter.] | Subscription $3.co year. Foreign $4.50 year. Single Copy 10 cents. | No. 25

STEEL CORPORATION ABSORBS UNION STEEL.

If it had been given out even a week ago, the announcement of the sale of all the properties of the Union Steel Co. to the United States Steel Corporation would have been a genuine surprise in iron and steel circles. Some rumors of the sale were in circulation, however, a few days before the positive announcement was made in Chicago on Tuesday, by Judge Elbert H. Gary, chairman of the board of directors of the Steel Corporation. This purchase is a very important one. It is so important that if it had included the Jones & Laughlins properties it would have meant the removal of the only large concerns that have really been regarded thus far as competitors of the big steel combination. A combination between the Union Steel Co. and Jones & Laughlins was talked of a short time ago. Jones & Laughlins still retain the personal identity that is said to have been such a great factor in keeping them out of combinations. The Union Steel Co. is in itself a merger of the Union Steel Co. of Donora, Pa., (near Pittsburg), and the Sharon Steel Co. of Sharon, Pa. Mr. Frick was very largely interested in the Union company. In a statement as to terms of the purchase, Judge Gary says:

"These plants were started some time before the formation of the United States Steel Corporation and not in opposition to it. They include rod, wire, nail and other works in operation as going properties. When fully completed they will have five modern blast furnaces and twenty-five open-hearth furnaces, with a capacity to manufacture 7,500 kegs of nails daily. They will also have new and modern tube mills, bar mills, tin mills, sheet mills, plate mills, etc. They have about 5,000 acres of coking coal in the Connellsville region, besides terminal railroads in the coke region, 6,200 acres of fuel coal on the Monongahela river, limestone properties and valuable developed ore mines in the Mesabi and Marquette regions containing about 40,000,000 tons of ore, two lake steamers and steel railroad cars.

"The Steel Corporation pays the exact cost of the manufacturing plants, etc., to be determined by auditors appointed for the purpose. For the real estate, ore properties and the coal lands they will pay something more than the cost value but not to exceed the present market value. The stockholders of the Union and Sharon plants agree to furnish about $10,000,000 new cash to be expended in the completion of improvements and further development of the properties in such manner as the Steel Corporation may determine. The manner of paying for the property will be by a bond issue of $45,000,000 secured on the property, and principal and interest guaranteed by the Steel Corporation. For the actual monev put into the manufacturing property the stockholders will receive these bonds at par. For the value of real estate, ore and coal, they will receive bonds at par, and for the $10,000,000 of new cash they will receive bonds at par. The remainder of the bonds will be kept in the treasury for use at some future time in such further developments of tne property as may be decided on by the Steel Corporation.

"The sellers' profit in the transaction arises solely from their profit in operating their plans to date and in the increased value of their ore, coal and real estate, which were purchased some time ago. This is an advantageous purchase for the steel corporation, as these properties are located near their other plants and the general expense of managing the business with the addition of these two large and modern plants will not be increased and also for the reason that the Corporation is now short of pig iron and open-hearth capacitv.

MR. CARNEGIE HOME AGAIN.

Mr. Andrew Carnegie arrived home last week from his Scottish home. He looked thin and ill but declared that he had entirely recovered from his sickness and was rapidly recuperating. He was met on the Oceanic by half a score of reporters and photographers. He has outgrown his aversion to the camera, for he posed for half a dozen of them very patiently. He expressed his opinion about affairs with his accustomed freedom. He thought the president's message very conservative and highly endorsed Attorney General Knox's views on trusts. Great corporations are the instruments of modern commercial activity. He believed that there are existing laws which could be used to correct abuses by the trusts. He spoke in favor of creating the proposed new cabinet position—that of secretary of commerce.

"Foreign commerce is a braggart" said he. "The regulation and cultivation of home commerce is more important tc the nation. This country consumes 96 per cent. of its manufactures. Home commerce is the most important because two persons are advantaged by every sale that is made."

Altogether Mr. Carnegie was cheerful and optimistic.

STEAMSHIP PARTS MUST PAY DUTY.

Foreign steamship companies have no longer any right to bring into the United States, duty free, spare parts of machinery to be stored in this country to be used on board their vessels. The attorney general holds that if such spare parts are actually landed they are subject to duty and that the only exception to be made is in case such parts are to be brought over to meet an emergency that already exists. The Cunard Steamship Co. asked permission to land a steel shaft without payment of duty, to be kept on the company's docks at New York for use on the steamships Umbria or Etruria in case of emergency. The application stated that the vessels were single-screws for which extra shafts are kept on hand at the home port in case of emergency. Reference was made to the fact that the Umbria had been detained at New York until a shaft could be brought over from England. It was added that the shaft was not intended for sale of for consumption in the United States. The attorney-general in his report to the secretary of the treasury says that if the shaft is landed, whatever its intended use may be, duty must be paid. Some time ago when the North German Lloyd Steamship Co. brought over some machinery to replace a defective part it was merely transferred from one ship to the other. The Cunard Steamship Co. cited this as an analogous case but the attorney-general held that it was not analogous. The secretary of the treasury has accordingly denied the application of the Cunard Steamship Co.

STEEL CORPORATION AFFAIRS

The eastern newspapers are now definitely speaking of a successor to Mr. Charles M. Schwab as president of the United States Steel Corporation. None of them have mentioned Mr. E. J. Buffington, president of Illinois Steel Co., although the Review hears from a reliable source that he will probably be offered the place. They all mention Mr. James Gayley, who is first vice-president of the Corporation, and Mr. George W. Perkins, who is chairman of the finance committee. Mr. Gayley, as is well known is experienced in the iron business. Mr. Perkins has no mechanical ability whatever. His specialty has always been finance, but it is reported that his executive qualities are of the first order and that he is a consummate master of men. Mr. Perkins was for a number of years connected with an insurance company in Cleveland, but for the past three or four years has been a partner in the firm of J. P. Morgan & Co. The drop of ten points in the preferred stock and of thirteen points in the common stock of the Corporation is not credited to adverse industrial conditions. The corporation has more business on its books than at any time since it was organized, and its profits during 1903 will, it is estimated, be greater than those of 1902 through various economies which have been perfected.

NILE DAM AT ASSOUAN FINISHED.

The great Nile reservoir and dam at Assouan, upper Egypt, which the Review has previously described, were formally opened to service on Dec. 10, in the presence of the khedive and several persons of the English nobility. The opening ceremony occurred when the khedive turned a key which put the electric machinery in motion, whereupon the sluice gates were opened and a large body of water rushed through them. The completion of the Assouan dam marks one of the greatest achievements in engineering and reservoir construction in the world. It crosses the Nile 600 miles above Cairo, and is built of granite blocks. The structure serves as an irrigating dam, a bridge and a waterway. It is 1¼ miles long, is pierced by 180 openings, 23 ft. high and 7 ft. wide, fitted with adjustable steel gates. The water can be dammed at a height of 347.6 ft. above the level of the Mediterranean. It is estimated that the work will add 2,500 square miles of arable land to Egypt. The revenue from the tax and sale of lands, it is estimated, will reach $10,000,000. No fewer than 16,000 laborers, 90 per cent. of them native Egyptians, have been engaged on the undertaking during the greater part of the time since the dam was started. Some idea of the work accomplished will be had by the statement that great artificial lakes 100 miles long, have been formed and that the volume of water empounded would be sufficient to provide the entire United Kingdom with drinking water for a year.

The Atlantic Transport Line's steamships Mesaba and Minneapolis will replace the American liners St. Louis and New York while the latter are being overhauled, beginning Jan. 17. This will mark the first use of Southampton by the Atlantic Transport Line for disembarking passengers.

MORE BOILER TRIALS.

British Admiralty orders another competitive run between Minerva and Hyacinth—Tests of torpedo boat destroyers—Few orders for new ships—Scottish ship building letter.

Glasgow, Dec. 4.—Another competitive run to Gibraltar is to be made by the cruisers Minerva and Hyacinth under conditions analogous to those laid down by the navy boiler committee, but on this occasion the trials will be conducted by the admiralty. They are chiefly intended for the testing of new propellers, the original screws having given remarkable results. The Hyacinth, although she had more engine power than the Minerva, did not realize so great a speed. New screws have now been fitted, which should yield important data. It is intended to take as complete information of the working of boilers and machinery as was made by the dock yard staff for the boiler committee. Neither type of boiler came out of the tests satisfactorily, for while the cylindrical boilers of the Minerva got choked at the tube ends by "bird-nesting" to such an extent that she could not have steamed further than Gibraltar anyhow, the Belleville boilers of the Hyacinth burned more coal per unit of power, and the tubes leaked at the point where they are screwed into the boxes joining each pair of tubes together. Some of the figures tabulated in the boiler committee's report were not reconcilable, and the admiralty has decided that a repetition of the competitive trials will be helpful in illuminating the boiler question. The two ships will leave in a week or so for Gibraltar at three-fourths power, the object being, as before, to cruise at that power until all the coal in their bunkers is consumed, each having, of course, the same quality of coal to begin with. They will return at the best speed possible.

The committee appointed by the admiralty to enquire into the strength of torpedo boat destroyers has decided to test a boat of this type to the point of destruction. The appointment of this committee followed the loss of the Cobra in the North sea. It is under the chairmanship of Admiral Fitzgerald and includes Dr. Inglis, Professor Biles, Mr. Archibald Denny and Mr. Deadman of the admiralty. Theoretical research has been conducted on an extensive scale, and it has been considered desirable to put the theories to the test of actual trials, so as to ascertain the breaking strength of a destroyer when regarded as a girder. One view taken when the Cobra was lost was that the vessel being alternately suspended between waves, leaving the center partly unsupported by water, and carried centrally on the top of a wave with the bow and stern unsupported, the resulting sagging and hogging action broke her back. This will be demonstrated in a dry dock at the Portsmouth yard with one of the destroyers now attached to the navy.

SHIP BUILDING RETURNS—FEW NEW ORDERS.

We are nearing the termination of the ship building year, the records of which will show a surprising amount of work, notwithstanding the highly unsatisfactory condition of the shipping trade. In Scotland during the eleven months ending November the output has been 495,000 tons, or just about 5,000 tons short of the total in the same portion of last year, and with that exception considerably ahead of any previous year. The Clyde proportion of the total was 452,000 tons as compared with 461,000 tons last year. There are some heavy vessels which will be probably put into the water this month, in which case the year's total for 1902 may possibly exceed the record one of 1901. The November launches were thirty-two vessels of 48,500 tons, comparing with twenty-five vessels of 56,900 tons in November last year. The new work booked during the month was under 5,000 tons and included no item of outstanding importance. Last month's output included a 7,600-ton twin screw built by D. & W. Henderson & Co. for the China Mutual Steam Navigation Co.; a 7,400-ton twin screw built by John Brown & Co., Ltd., for the Federal Steam Navigation Co.; a 6,200-ton boat built by D. J. Dunlop & Co. for the German American Petroleum Co., Hamburg; a 5,800-ton cargo boat built by Charles Connell & Co., Ltd., for Liverpool owners; a 5,000-ton boat built by Scott & Co. for the Clyde Shipping Co.; a 4,500-ton boat built by the Grangemouth & Greenock Dockyard Co. for the Pure Oil Co.; a 4,000-ton cargo boat built by Russell & Co. for Liverpool owners; a 1,600-ton boat built by Gourlay Bros. & Co., Dundee, for the Netherlands Steamship Co.; a 1,100-ton boat built by Murdock & Murray for the Co-operative Wholesale Society, Manchester; a sailing vessel of 1,750 tons built by the Ailsa Ship Building Co. for Glasgow owners; and a number of small special steamers, fishing steamers, tug steamers, hoppers, barges and launches.

The great drop in new contracts in November seriously affects the prospects on the Clyde where hitherto and till now there has been more activity in the ship yards than elsewhere. The price of steel ship plates has been reduced to £5 10s. in the north of England and correspondingly here, but the reduction is not enough to tempt ship owners to order. It is expected that iron and wages will be lower next year, and therefore shipbuilding costs also. The Clyde ship yards are now on to their winter schedule of forty-eight working hours, instead of fifty-four as in the summer schedule. The trade unions concerned with the work of the ship yards lately approached the Clyde Ship Builders' Association with a joint request for the abolition of the fortnightly and the reintroduction of the weekly system of payment of wages. A few years ago the ship builders gave the weekly system a year's trial on the condition on their part that if it proved a success generally and did not lead to a further loss of time, they would adopt it permanently; and on the part of the men that if it did prove a failure, or materially unsatisfactory, the fortnightly system should be restored and maintained without further question. At the end of the year it was found that the weekly system had involved such a loss of time and irregular working that the employers declared it a failure. The fortnightly system was restored and has been (as agreed with the men) in operation ever since. In applying once more for the weekly system they referred to it as in operation almost everywhere else than on the Clyde. The employers, however, have replied that after full trial it was found far from a success here, being conducive neither to the profit of the employers nor to good time-keeping by the men. After careful consideration of the application of the men the employers have intimated that they cannot make any further change and they request the trade unions to regard this decision as final.

NEW ARMORED CRUISERS.

It is now stated that the orders for the two new third-class cruisers have been placed with English firms, and that the order for the first-class armored cruiser will be given to the Armstrong company. One of the third-class vessels is to be built by the Palmer company, and the other by Laird Bros. of Birkenhead, who have already in course of construction one of the same type ordered eight months ago. These vessels are improved Pelorus cruisers, having a displacement of 3,000 tons, their lengths 360 ft., their beam 40 ft., while their draught at full load will be 14 ft. 6 in. The Palmer company's vessel will be fitted with the Reed small-tube boiler and the Laird vessel will have Laird-Normand boilers. Both vessels will have reciprocating engines with high-pressure cylinders 14¼ in., three intermediate cylinders 38½ in., and two low-pressure cylinders 42¼ in., with a stroke of 24 in. Running at 250 revolutions the engines will indicate 9,800 I. H. P., which, it is anticipated, will give a speed of 21¾ knots. These vessels will depend for protection on an armored deck, and for armament will have twelve quick-firing guns of 4-in. caliber, eight 3-pounders, and three Maxims, with two torpedo launching tubes under the water line. The vessels are to be completed in twenty-one months, heavy penalties being specified for late delivery.

Ship builders everywhere are naturally interested in the efforts which are being made to influence the admiralty to give the order for the armored cruiser for which tenders were recently received to a London firm. The policy pursued recently by the admiralty has been to order ships from different districts, so as to distribute the work and ensure prompt delivery, but this has been done with a due regard to cost. Once this item of cost is omitted, political or other influences may be brought to bear on the question of contracts. There is the important question also of the lack of modern plant and facilities in the London yards and the great cost of completing a ship at a long distance from either the ship building or the engineering works. The encroachments of shipping have, as in Liverpool, altered the conditions and these necessarily compel the removal of large warship work from London. As to maintaining a yard in London for repairing warships, naval officers do not support the idea, because the time lost and the risk involved in taking a large ship up the Thames would introduce a dangerous element of delay. The Chatham and Sheerness dock yards are already available for the overhaul of a North Sea fleet. The Thames lost its ship building industry many years ago by the folly of the trade unions, the admiralty cannot restore it.

STEEL BARQUE OF 3,000 TONS.

From the yard at Troon of the Ailsa Ship Building Co. there was launched on Saturday a steel barque of 1,500 tons register. The principal dimensions of this vessel, which has a deadweight capacity of 3,000 tons, are: Length over all, 273 ft. 6 in.; length between perpendiculars, 252 ft.; breadth molded, 39 ft.; depth molded, 24 ft. 4 in. She was built under special survey to class 100 A1 at Lloyd's and is owned by the Kildalton Barque Co., Ltd., of Glasgow. The Ailsa Ship Building Co. has the marquis of Ailsa as chairman and it operates in a harbor made by the dukes of Portland. The fourth duke of Portland built at Troon a tidal basin of considerable depth of water, and a graving dock which was then (1808) the largest in Scotland. He also formed a railway, the first in Scotland between Kilmarnock and Troon, and erected the first steam crane in the country for shipping coal. Then he started ship building in Troon, and in 1831 there was built in the yard a 10-gun brig, which was so much ahead of the frigates of those days that the duke presented her to the admiralty. In the fifties Troon also built the largest wooden ship that had been put into the water in Scotland up to that time, and some time later there was launched from the yard the first steam collier that carried coal between Great Britain and Ireland. When the fifth duke succeeded to Troon harbor he spent large sums in improving and developing the port and during the twenty-two years of his proprietorship the present duke has followed the example. A large new grav-

ing dock was built and the Ailsa Ship Building Co. was installed as tenant of the adjoining yard. In August, 1901, the present duke of Portland sold Troon harbor to the Glasgow & South Western Railway Co., believing that it was not the province of an individual to hold a harbor in these days of keen competition. The Glasgow & South Western officials have decided to remodel and improve the harbor of Troon with the object of bringing larger vessels to the port.

NOT AT ALL IN FAVOR OF SUBSIDIES.

At a recent meeting of ship owners Mr. Walter Runciman, M. P., (a ship owner) spoke of the relation of subsidies to tramp steamers. He said that where subsidies were regularly given by governments tramp shipping languished. Subsidies given to particular liners would be unfair to other liners, and if given to all liners would be unfair to tramps. The future of tramp shipping depended, he said, not on subsidies, but on foresight, skill, and the enterprise of those engaged in shipping. He quoted the latest statistics showing that the gross tonnage of British tramps was nearly 8,750,000, against the liners' 5,000,000. As for the Cunard agreement, from the admiralty point of view the country might have got a *"quid pro quo"* but if it was done with a commercial intention on account of the Atlantic combination his opinion was that the government had committed an error of judgment. Sir Theodore Doxford, M. P., (a ship builder) maintained it was a misnomer to speak of subsidies for British ships, either liners or tramps. So far the payments by the government had been only for services rendered.

A 10,000-TON OIL CARRIER.

There was launched a few days ago from the yard of Sir W. G. Armstrong, Whitworth & Co. (Ltd.) at Walker-on-Tyne, a steamer built to the order of the Shell Transport & Trading Co. This vessel was christened Silverlip, is 486 ft. in length, 55 ft. 3 in. broad, and 35 ft. deep. She is capable of carrying a total deadweight of 10,100 tons on a draught of 26 ft. 6 in., and has been designed for taking cargoes of oil eastward and for bringing home general cargoes, including even tea and silk. The problem of cleansing the vessel for the latter purpose has been solved by Sir Marcus Samuel, the chairman, and his consulting engineers. Sir Marcus Samuel has always advocated the claims of liquid fuel as superior to those of coal, but the cost of the former has hitherto prevented its taking the place of coal. With the extension and development of the Shell Transport & Trading Co. that obstacle is likely to be at least materially diminished. There is no doubt in many quarters that oil fuel is destined to play an important part in the immediate history of the mercantile and naval services. The Armstrong company is now engaged on a series of experiments to determine the best form in which it can be applied to the boilers of ships of war, where high powers are required from comparatively small boilers. Sir Marcus Samuel says his business associates always desired, while earning money, that they might benefit the whole community. If oil has such enormous advantages over coal, let them by all means export their coal and give work to the miners at home whilst importing a better substitute as fuel and giving work to the ship builder. Sir Andrew Noble (chairman of the Armstrong company) says that Sir Marcus Samuel has done more than any man in England to bring forward oil as a fuel for maritime purposes. At Walker, Sir W. G. Armstrong, Whitworth & Co., have done much in that direction, and of late circumstances have brought very strongly to their notice the importance of oil fuel for men-of-war.

NEW FORM OF STEERING GEAR.

A new form of steering gear, in which the motive power was electricity, was fitted a year ago on board the steam yacht Valhalla, built in 1892 by Ramage & Ferguson, Ltd., Leith, for the earl of Crawford. The gear, which was used during a five months' cruise in foreign waters, was a patented invention of the Hon. R. Brougham, in collaboration with J. S. White & Co., Ltd., ship builders and engineers, East Cowes, and Siemens Bros. & Co., electrical engineers, Woolwich. After the cruise referred to certain improvements were made on the gear, and last week it was tested thoroughly. The helm was put from hard over to hard over time after time when the ship was steaming full speed ahead, and also when steaming full speed astern, without the slightest sign of distress in any of the gear. The vessel has now proceeded on a voyage round the world, and those on board have confidence that the new gear, which can be changed from electric to hand or *vice versa* by one pull of a lever, will prove itself reliable under all conditions. In addition to the electric steering gear Siemens Bros. & Co. have devised a means by which any form of steering engine, steam or electric, may be controlled from any position in a ship in which electric circuits are fixed without the usual shafting and connecting wheels, so that a captain can steer from masthead, forecastle or any other suitable position.

The famous cruiser Terrible is coming to the Clyde for extensive overhaul by John Brown & Co., Ltd. Not only will the boilers and machinery be thoroughly overhauled and many of the fittings of the ship renewed but important structural alterations will be made, and the gun power increased. As originally built the Terrible had two single-story casemates in the waist of the ship on the main deck. Over these on the upper deck a casemate will now be built with 6-in. armor, and she will then have, like the Drake class, four two-story casemates on each broadside, each with 6-in. quick-firing guns. Under the new arrangement of giving out repair work to private firms, John Brown & Co., Ltd., have got the Pelorus, the Aurora and the Terrible to put into condition.

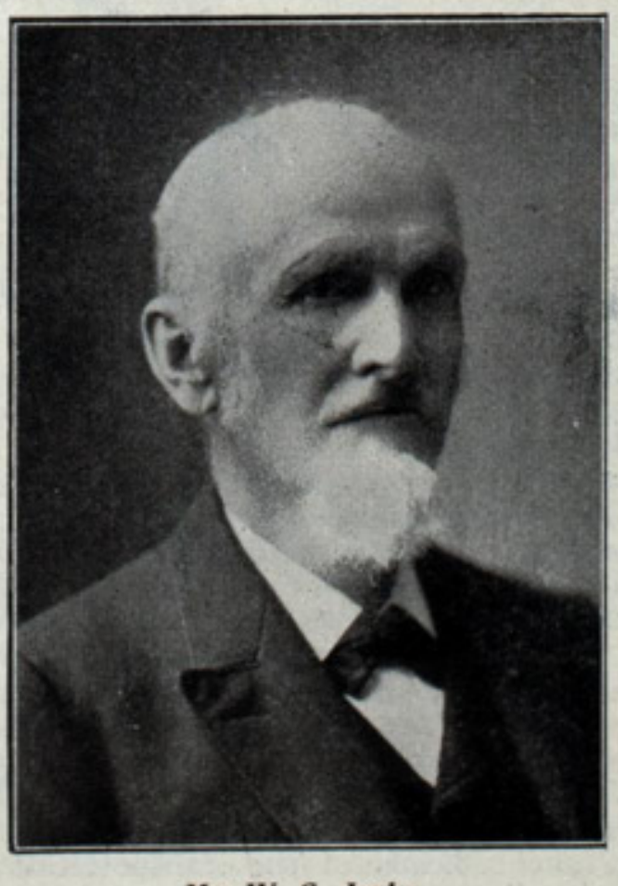
BIG BOAT RACE BETWEEN CREWS.

The biggest boat race in the history of the American navy is soon to take place in the Caribbean sea where the squadrons are holding their winter maneuvers. The race will take place between crews representing various fighting vessels. The crew of the gunboat Nashville of the European squadron, one of the vessels mobilizing in the Caribbean, is the holder of the cup which was won in an exciting race in the harbor of Villefranche last April from crews representing the other vessels attached to Admiral Crowninshield's squadron. It required the greatest efforts on the part of the Nashville's men to win the trophy, which is the gift of James Gordon Bennett. The crew has held the cup ever since.

When the North Atlantic, the South Atlantic, and the European squadron, as well as most of the battleships and cruisers unattached, were ordered to mobilize in the Caribbean sea for the winter maneuvers, the Nashville's crew immediately decided to make an effort to win the championship of the navy and issued a challenge for a race to every vessel that was to take part in the regular evolutions. Accordingly the challenge was issued and ship after ship has accepted the defi, and now nearly all of the fifty-odd vessels assembled in the southern seas have signified their intention to dispute with the Nashville's crew its right to the championship. The question now to be decided is the time and place of the race and the judges. The judges, although as yet unselected, will probably be Admirals Dewey, Crowninshield, Sumner and Coghlan, the four senior commanders of the huge fleet that is to engage in mimic warfare. To get an idea of what a splendid race the forthcoming contest will be it is only necessary to enumerate a few of the ships that are at present in the Caribbean. There is for instance the great battleship Iowa, Admiral Evans's own ship, which has turned out winning crews time and time again; the Illinois, whose crew has been vanquished by the Nashville, but who will be allowed another chance; the Olympia, Admiral Dewey's famous flagship; the battleships Alabama, Kearsarge, and the Massachusetts, besides about forty other vessels, big and small, each boasting a set of men that they aver can outsail anything in the American or any other navy.

The boat crew of the gunboat Nashville, the champions of the European squadron, has probably the most enviable record in the United States navy. Besides the Bennett cup, they also hold a cup won at Colombo, in which they worsted the crew of the American cruiser Albany, and one of the crack crews of the British Indian squadron. The English boat the men of the Nashville met on that occasion was considered the crack boat of the British fleet, and the record shows that the British craft was easily beaten. On another occasion, in a race with the Illinois boat, the Nashville's men say that the officers of the flagship had the boatswain's mate of the Nashville barred from sailing the cutter. In spite of this, the Illinois's crew was never in the race to any appreciable extent. The Nashville crew has had many other races besides these to its credit, and they have yet to meet a crew that can beat them across the finish line. The big race now about to be pulled off will decide whether there is such a crew in the American navy.

DEATH OF MR. W. S JENKS.



Mr. W. S. Jenks.

Mr. W. S. Jenks, senior member of the Jenks Ship Building Co., died very suddenly in the office of the company at Port Huron last Friday afternoon. He was seated in a chair and was seized with a dizzy spell, and before help could be summoned had passed away. Death was entirely painless. Mr. Jenks was eighty-four years of age. He had been a resident of Port Huron for a great many years. With his brother, Orrin Jenks, he founded the Phœnix Iron Works of Port Huron and later started the ship yard. Both industries were subsequently merged into the Jenks Ship Building Co. It is one of the leading industries of Port Huron.

NEWS OF THE GREAT LAKES

A FINE LAKE STEAMER.

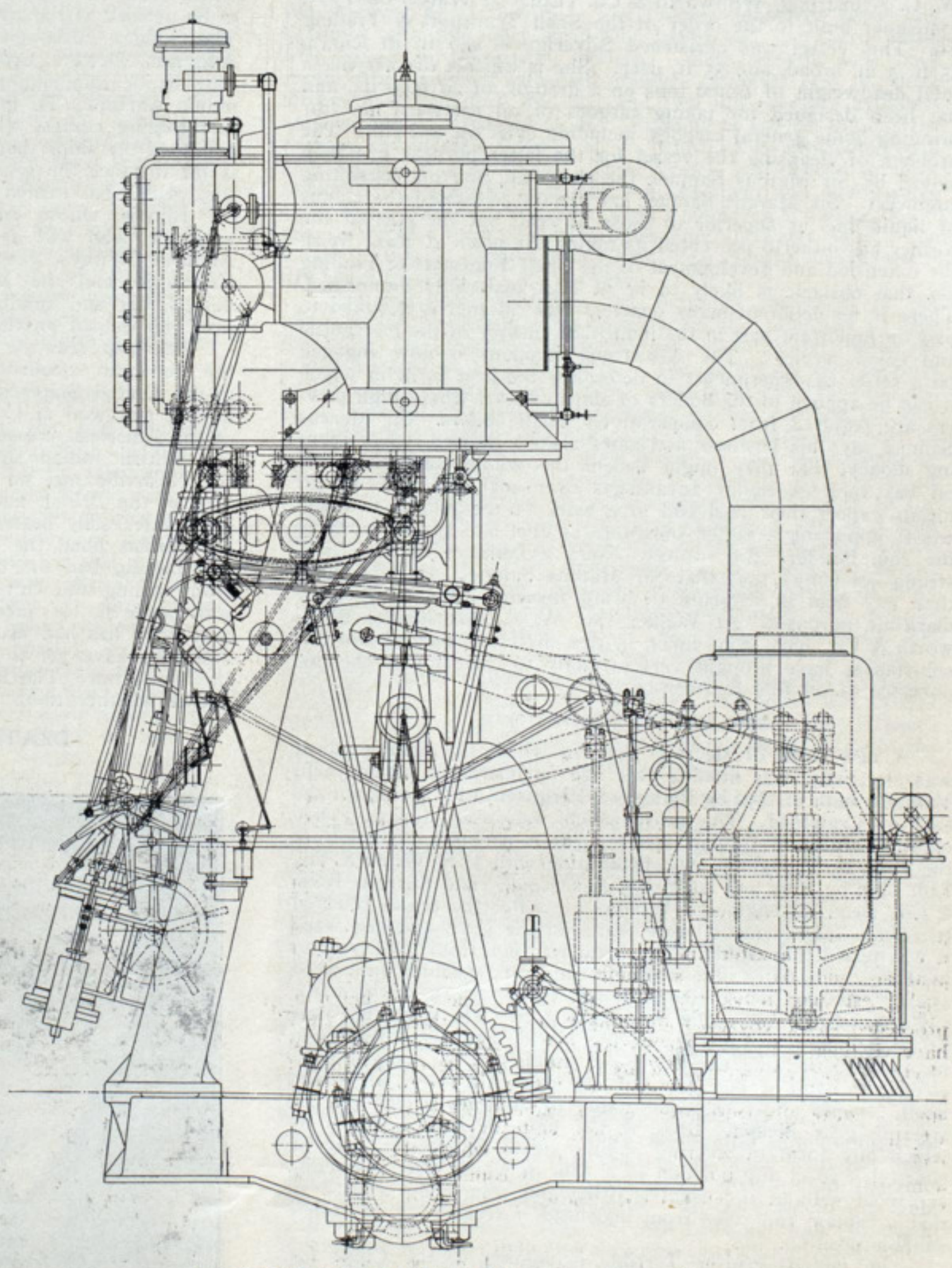
Launch of the Anchor Liner Tionesta at the Wyandotte works of the Detroit Ship Building Co.—A passenger and freight ship that is modern in every detail and sure to attract a big patronage in Lake Superior tourist travel.

Detroit, Dec. 17.—The steamer Tionesta, launched on Monday at the Wyandotte works of the Detroit Ship Building Co., is certainly a vessel worthy of more than the passing attention given to the big ships that have been going into the water every few weeks of late from lake yards. For a great many years the Erie & Western Transportation Co., better known as the Anchor Line of Buffalo, and which is closely related to the Pennsylvania railroad, has conducted a passenger and freight service between Buffalo and Duluth that has enjoyed merited popularity. The passenger part of it has been what is known as an inclusive service—transportation, meals and berth at one fixed rate, the lowest consistent with first-class accommodations. It was not widely advertised—that was not necessary as the boats were all the time filled—but it was very well managed by a force that included, even to the captains and engineers, men who had been in the company's employ for as much as thirty years. Mr. Frank J. Firth, vice-president of the company, is probably best known on account of the active part he has taken in affairs of the Lake Carriers' Association, of which he is a past president. Mr. E. T. Evans of Buffalo, the western manager, was the owner and David Bell of Buffalo the builder, in 1862, of the steamer Merchant of 800 tons capacity, with accommodations for sixty passengers, the first metal hull vessel constructed for lake service. Later the Anchor Line built and owned the iron steamers India, China and Japan of 1,300 tons capacity, with accommodations for 125 passengers. Mr. Evans' connection has been continuous with the various organizations of which the Anchor Line is the successor. Capt. Charles Christy, who is to command the vessel just launched, has been in the employ of the company since 1875, and the service of Mr. John Wise, who is to be engineer of the new vessel, extends back to 1872. These incidents would indicate that in undertaking the building of a new fleet (other vessels similar to the Tionesta will undoubtedly follow a little later on) the officials of this company have the experience that will enable them to provide what is best suited to the business in which they have been engaged.

Mr. J. C. Evans, general western agent of the Anchor Line at Chicago, attended to the entertainment of the launching party, which included a number of guests from lake cities other than Detroit. Readers of the Review are, of course, more interested in the vessel than in the social features, and it will probably be sufficient to say that Mr. Evans not only carried out most admirably a full day's program of enjoyment for everyone present but also succeeded in incidentally making a great many friends for the Anchor Line. Among other officials of the transportation company present were Charles E. Markham, general passenger agent; Charles Strasmer, superintendent of repairs; Charles E. Fox, chief engineer; E. H. Chase, chief steward, and P. E. Bourke, Detroit agent. The vessel was christened by Miss Marie B. Wetmore of Detroit, and the launch, which was attended with the usual care exercised at the Detroit works, was in every way successful. Of course Messrs. Frank E. Kirby, C. B. Calder and A. George Mattsson, who are responsible for the designs of Detroit ships, as well as Secretary M. E. Farr, were present, on account of the special interest they would have in the launch of such a vessel as the Tionesta.

When ready to go into commission next spring this vessel will be placed on the Buffalo-Duluth route with the steamers India, China and Japan, and the intermediate ports of call will be Cleveland, Detroit, Mackinac island, Sault Ste. Marie, Marquette, Houghton and Hancock. The schedule for the new vessel will be based on a running speed of 14 miles an hour, the round trip between Buffalo and Duluth occupying ten days as against thirteen days for the smaller boats.

Plans of the Tionesta were printed in the Review of Feb. 20 last. Engine plans are presented herewith, and a good picture of the ship will be found in a colored supplement accompanying this issue. The principal hull dimensions are: Length over all,



Quadruple-Expansion Engines of Anchor Line Steamer Tionesta.

360 ft.; length of keel, 340 ft.; beam, 45 ft.; depth, 28 ft. The whole construction is of steel up to the promenade deck. The hull is divided into nine water-tight compartments by eight bulkheads. There is a double bottom with a water ballast capacity of 900 tons. The cargo capacitv is 3,500 tons, coal bunker capacity 350 tons and total passenger capacity of 350.

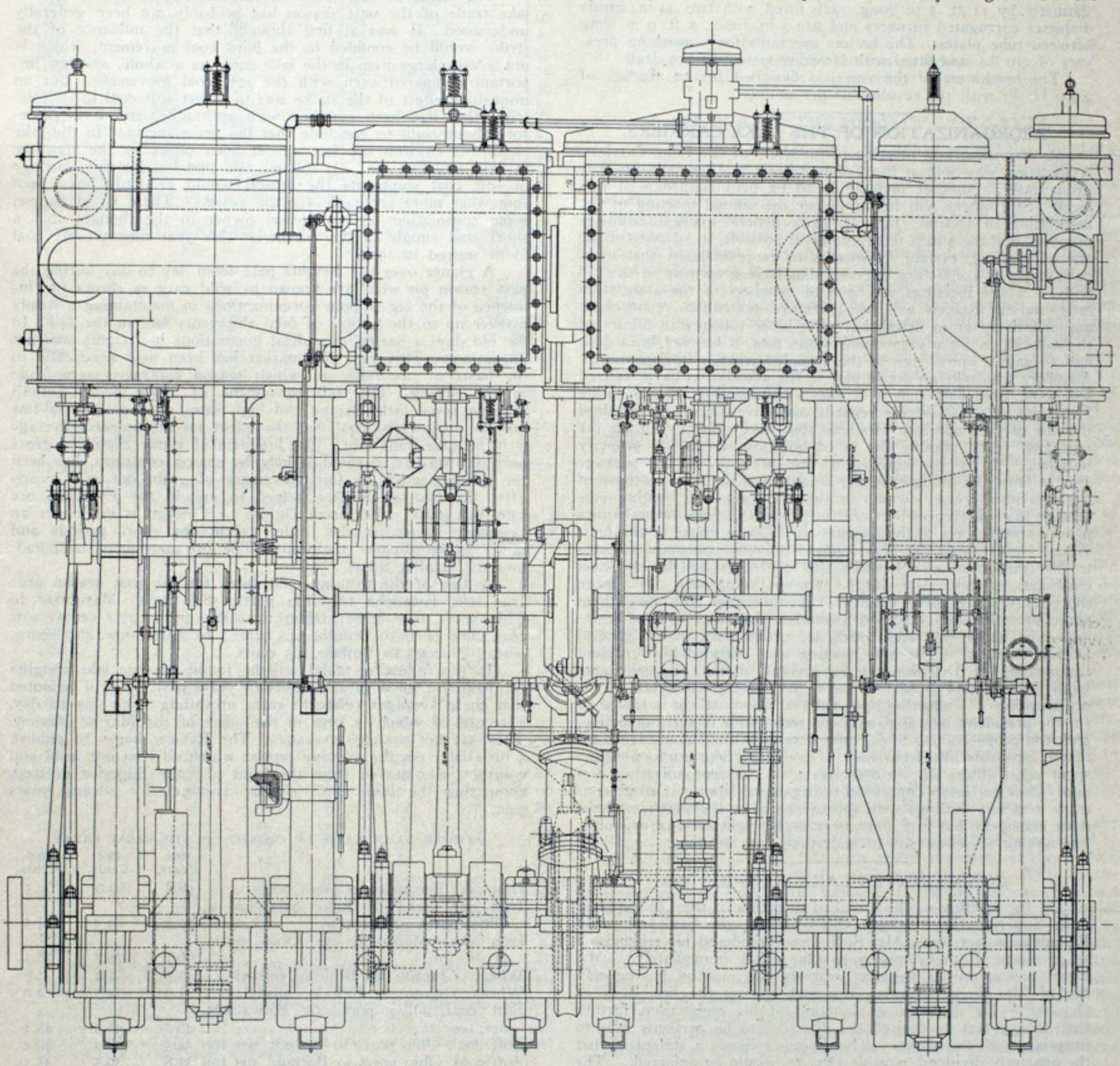
A feature of the vessel is the location of the dining saloon and social hall, which are on the deck above the sleeping cabins. The entrance for first-class passengers is located amidship on the main deck, and occupies a space of 20 ft. in length extending entirely across the ship, from which broad stairs lead to the berth deck. The berth deck occupies the full width of the ship and is arranged with four lines of state rooms extending from the forward bulkhead to the stack. The rooms are exceptionally large, each containing two berths, a cushioned sofa, porcelain lavatory supplied with water under pressure, electric lamps and service calls.

The lobby, located amidship on the berth deck, will be finished in quartered white oak. On either side of the lobby will be the offices of the purser and steward, and from this part of the ship general access to all state rooms, lavatories, bath rooms and barber shop will be had. From this point also, by a wide flight of stairs, the social hall, music room, dining saloon and promenade deck will be reached.

Immediately forward of the social hall there are eight large parlor rooms, each provided with a double bed, cushioned sofa, clothes press, separate bath and toilet room; and forward of these rooms is the music room and library, 70 ft. in length, having large plate glass windows and mahogany paneling. Aft of the social hall and amidship on the promenade deck is the dining saloon with a seating capacity for 136 passengers. This room is finished in mahogany and a dome skylight extends its entire length. Large plate glass windows on both sides, on the line of the dining tables will give passengers at meals an unobstructed view. Aft of the dining saloon are the galley, pantry, store room, refrigerators and mess rooms for officers and crew.

The smoking room is at the extreme after end of the promenade deck and is to be fitted out in a most attractive and comfortable manner. In fact, the smoking room is to be one of the most attractive features of the ship. The furnishings of the vessel will leave nothing to be desired. Special attention is being given to every detail of furnishings.

On the upper deck are located the pilot house and officers' quarters, with additional promenade for passengers. On the main deck aft, quarters are provided for second-class passengers with a separate entrance.



Quadruple-Expansion Engines of Anchor Line Steamer Tionesta.

The quadruple expansion engine of the Tionesta, designed by Mr. A. George Mattsson of the Detroit works, is of the vertical, inverted, jet-condensing type. The cylinders are 22, 31½, 45 and 65 inches diameter with a common stroke of 42 in. The high-pressure and first-intermediate cylinders are fitted with piston valves, the second-intermediate and low-pressure cylinders with double-ported slide valves. All valves are worked by means of the ordinary link motion and also with rockers for middle cylinders to reduce the fore-and-aft space. The second-intermediate and low-pressure cylinders are placed in the middle, to obtain proper balancing, and for the same reason the different cranks have been placed in certain relation to one another. The crank shaft, 13 in. in diameter, is made in two parts and supported in six journals. The crank pins are 13 in.

diameter and 11 in. long. The propeller is 14 ft. in diameter. The engine is fitted with steam as well as reverse and turn-over gear. The air pump and cooler pump are worked by means of levers from the low-pressure cylinder cross-head and the bilge pumps from the first-intermediate cylinder cross-head. The feed pump is of the independent type. Sizes of pumps are: Air pump, 40x12 in., single-acting; feed pump, 14 and 18 in. by 12 in., simplex, double-acting; auxiliary feed pump, 14 and 8½ in. by 10 in., duplex; fresh water pump, 6 and 7½ in. by 8 in., duplex; sanitary pump, 6 and 7½ in. by 8 in., duplex; ballast pump, 10 and 16 in. by 12 in., duplex. In the engine room is also placed a double 9x12-in. vertical, line-shaft hoisting engine, as well as electric lighting and refrigerating machinery.

The steam is supplied by four cylindrical boilers, 12 ft. 6 in. diameter by 11 ft. 3 in. long, each fitted with two 44-in. inside diameter corrugated furnaces and 242 3-in. tubes, 7 ft. 9 in. long between tube plates. The boilers are built for a working pressure of 210 lbs. and fitted with Howden system of hot draft.

The machinery of the vessel is designed for an average of 2,500 H. P. with 100 revolutions per minute.

REORGANIZATION OF THE LAKE CARRIERS.

A very important meeting of members of the Lake Carriers' Association was held at the Colonial hotel in Cleveland on Saturday last. Another meeting is to be held Saturday of this week. Still others will follow before the annual meeting of the association in Detroit, Jan. 22, as a general reorganization is proposed and the aim is to overcome, if possible, in advance of the annual meeting, certain drawbacks to reorganization that exist on account of conflicting interests that have grown up in the old body. These meetings are open to members of the association only, and the Review will not, therefore, pretend to report them authoritatively or in detail, but after close touch with affairs of the association for a great many years past, it has not been difficult to gain a knowledge of the scope of what is now proposed. Members who take an active part in the association have realized for some time past that a stronger organization, one of more force and responsibility as regards executive officers, is required if some of the important problems that have come up during the past two years, notably the labor question, are to be properly handled. It is no secret that the interests of the package freight lines of Buffalo have not always been the same as those of the individual vessel owners or the ore companies owning vessels, or that differences between these interests have several times proved troublesome in the association. The interests of the individual vessel owner are also opposed in some important respects to the transportation companies that are controlled by the steel combinations and the large mining companies. To more thoroughly unite these classes of membership and have them agree upon the best common ground is the object of the meetings now under way and which are preliminary to the general Detroit meeting. The first meeting was attended by President Livingstone of Detroit, and by several of the line managers from Buffalo, and is said to have given every assurance of reorganization. Under the new order a liberal salary is talked of for the president, who is to give his entire time to the association, and it is proposed also to pay members of a small executive committee, probably one from each of the large lake ports, for time spent upon affairs of the association. The reorganization certainly does not mean opposition to organized labor. On the contrary it means dealings with the unions after the practice of the dock managers, but first contemplates the right kind of organization among vessel owners to undertake such dealings.

CONSOLIDATED LAKE SUPERIOR CO.

At the meeting of the board of directors of the Consolidated Lake Superior Co. (Clergue enterprises at the Sault), held in Philadelphia last week, Mr. F. S. Lewis tendered his resignation as president of the company to take effect immediately. Mr. Lewis has served as president scarcely two months, having succeeded Mr. E. V. Douglas, resigned, during the last week of October. He made no explanation of his resignation further than to say that he desired the directors to be perfectly free to negotiate with the banks. The directors issued a statement that the quarterly dividend, payable Dec. 15, would be deferred. The stocks, both common and preferred, broke sharply, the preferred dropping to 33¾ and the common to 6. It is understood that the company has arranged for the loan of $1,000,000 from various trust companies of Philadelphia, New York and Baltimore. The rail mill at Sault Ste. Marie had shut down for want of pig iron, but Mr. Clergue wired the directors that it would resume on Dec. 22. Mr. Clergue looked upon the stock flurry without alarm. He was inclined to think that the break had occurred through sensational reports sent out from Sault Ste. Marie to the newspapers regarding the temporary stoppage of work in the steel mill.

Congressman Ryan has introduced a bill in the house of representatives to authorize the Mather Power Bridge Co. of New York to construct a power bridge in the Niagara river near Buffalo. The bill provides that a clear span of not less than 200 ft., maintained by means of a pivoted draw, shall be provided for vessels.

AVERAGE LAKE FREIGHTS—SHIP EARNINGS.

Earnings of the lake freighters in the season just closed have been about the same as in 1901, notwithstanding the great delays in port, especially at the ore docks of Lake Erie. Of course there have been some exceptions, but as a rule the big steel ships have been able to divide on the season's work about 10 per cent. among stockholders, in addition to retiring the usual portion of bonds. Some of them have even done better. On the other hand some of the wooden vessels of the older and smaller class have undoubtedly had a hard time making both ends meet, mainly on account of the short coal movement and the delays which they encountered in getting coal cargoes after being chartered.

The effect of the strike of anthracite coal miners on the lake trade of the past season has probably not been generally understood. It was at first thought that the influence of the strike would be confined to the hard coal movement, which is not a very large item in the lake trade as a whole, and not important compared even with the soft coal movement. But an immediate effect of the strike was to divert soft coal to the districts that had been supplied with anthracite, and it is therefore about right to conclude that the great increase in the lake shipments of iron ore has almost been offset by the shortage in hard and soft coal. It follows also that but for this shortage in soft coal shipments the season would certainly have been somewhat more profitable for the vessels. There is, of course, some consolation for the vessel owner in the thought that a short coal supply in the northwest this year means more coal to be moved in 1903.

A glance over the freights paid from day to day during the past season on what are known as wild cargoes shows the influence of the big shipping organizations in maintaining a steady market up to the period of final shipments late in the fall. In the old days a season of radical fluctuations in freights was not uncommon. This year the market has been held practically to the basis of ore rates on which season contracts were made in the spring. The fall movement of grain from Duluth brought some little change and high rates were paid on a few tail-end cargoes of coal, but the effect on the season's average is in no case important. The big item of about 28,000,000 gross tons of iron ore, covered largely by season contracts, has been the ruling factor. A fair movement of grain out of Chicago after the first of August helped to uphold the Escanaba ore rate, but grain either from Duluth or Chicago is no longer an important factor in the trade, except for short periods and under extraordinary conditions. The ore movement overshadows the smaller items.

A few of the average wild rates for the past season are: Iron ore, Escanaba to Ohio ports, 58.8 cents; Marquette to Ohio ports, 66.1 cents; Duluth to Ohio ports, 77.2 cents; soft coal, Ohio ports to Duluth, 34.5 cents; to Milwaukee, 46.7 cents; wheat, Chicago to Buffalo, 1.5 cents.

In the following tables will be found average lake freights for 1902 and for a great number of years past. It will be noted that these averages relate to rates prevailing from day to day, a record of which is kept in the office of the Marine Review. They are not tonnage averages. The Review hopes to publish a little later on, the average rate at which all iron ore, wild and contract, was moved from the head of Lake Superior in 1902, comparing the same with similar averages for several years past.

AVERAGE DAILY RATES OF FREIGHT ON THE GREAT LAKES.

	1902. Cents.	1901. Cents.	1900. Cents.
Iron ore, Escanaba to Ohio ports	58.8	63.9	69.5
Iron ore, head of Lake Superior to Ohio ports, gross ton	77.2	89.3	84.5
Iron ore, Marquette to Ohio ports, gross ton	66.1	78.7	78.3
Wheat, Chicago to Buffalo, bushel	1.5	1.4	1.8
Wheat, Duluth to Buffalo, bushel	1.9	2.3	2.0
Soft coal, Ohio ports to Milwaukee, net ton	46.7	48.9	45.4
Soft coal, Ohio ports to Duluth, net ton	34.5	38.3	40.2
Soft coal, Ohio ports to Portage, net ton	31.8	39.5	41.3
Soft coal, Ohio ports to Manitowoc, net ton	41.9	48.1	43.6
Soft coal, Ohio ports to Sheboygan, net ton	41.9	45.3	43.6
Soft coal, Ohio ports to Green Bay, net ton	46.7	48.7	45.0
Soft coal, Ohio ports to Escanaba, net ton	41.4	46.0	40.0
Hard coal, Buffalo to Milwaukee, net ton	42.3	50.2	48.5
Hard coal, Buffalo to Chicago, net ton	42.3	50.2	48.5
Hard coal, Buffalo to Duluth, net ton	32.8	38.4	39.5
Lumber, head of the lakes to Ohio ports	254.9	266.0	233.7

AVERAGE DAILY FREIGHT RATES, TEN YEARS ENDING WITH 1902.

	Cents.
Iron ore, head of Lake Superior to Ohio ports, gross ton	84½
Iron ore, Marquette to Ohio ports, gross ton	73½
Iron ore, Escanaba to Ohio ports, gross ton	61

	Cents.
Soft coal, Ohio ports to Milwaukee, net ton	45
Soft coal, Ohio ports to Duluth, net ton	35
Hard coal, Buffalo to Chicago, net ton	46
Hard coal, Buffalo to Duluth, net ton	31
Wheat, Chicago to Buffalo, bushel	1⅝

AVERAGE RATES ON WHEAT PER BUSHEL FROM CHICAGO TO BUFFALO.

Year.	Rate, cents.	Year.	Rate, cents.	Year.	Rate, cents.
1860	9.89	1874	4.03	1888	2.56
1861	11.53	1875	3.42	1889	2.51
1862	10.49	1876	2.90	1890	1.96
1863	7.51	1877	3.72	1891	2.38
1864	9.58	1878	3.07	1892	2.19
1865	9.78	1879	4.74	1893	1.66
1866	12.34	1880	5.76	1894	1.27
1867	6.67	1881	3.44	1895	1.97
1868	7.14	1882	2.50	1896	1.70
1869	6.81	1883	3.41	1897	1.56
1870	5.88	1884	2.18	1898	1.53
1871	7.62	1885	2.02	1899	2.71
1872	11.46	1886	3.68	1900	1.79
1873	7.62	1887	4.13	1901	1.42
Average forty-three years, 4.69 cents				1902	1.51

Charges to vessels for shoveling, trimming and tallying weights of grain amounted to about $4.15 per 1,000 bushels in 1902.

RANGE OF LAKE FREIGHT RATES ON WHEAT FROM DULUTH TO BUFFALO

Year.	Rate, cents.	Year.	Rate, cents.
1902	1.9		
1901	2.3	1893	1¼@3½
1900	2.0	1892	2¼@4
1899	3.6	1891	1¾@9½
1898	1.8	1890	2 @5
1897	1.75	1889	2 @5
1896	2.12	1888	2 @5
1895	3.50	1887	2 @8
1894	1¼@3.	1886	3¼@8

Figures for eight years past represent average of daily rates for full season; previous to 1895 the rates are highest and lowest in the different seasons.

AVERAGE FREIGHT RATES ON IRON ORE PER GROSS TON, FROM PORTS NAMED TO OHIO PORTS—TABLE COVERING WILD AND CONTRACT RATES FOR TWENTY YEARS PAST.

	Escanaba.		Marquette.		Ashland and other ports at the head of Lake Superior.	
Year.	Wild or daily rate.	Contract rate.	Wild or daily rate.	Contract rate.	Wild or daily rate.	Contract rate.
1883	$1.22	$1.00	$1.40	$1.20	$....	$....
1884	.87	1.10	1.08	1.35	....	....
1885	.78	.90	.98	1.05	1.25	1.15
1886	1.28	1.05	1.51	1.20	1.78	1.20
1887	1.59	1.40	1.87	1.63	2.23	2.00
1888	1.05	.90	1.30	1.15	1.43	1.25
1889	1.01	1.00	1.19	1.10	1.34	1.25
1890	.89	1.10	1.07	1.25	1.17	1.35
1891	.84	.65	1.02	.90	1.11	1.00
1892	.74	1.00	.98	1.15	1.15	1.25
1893	.56	.85	.71	1.00	.77	1.00
1894	.47	.60	.60	.80	.78	.80
1895	.73	.55	.92	.75	1.13	.80
1896	.52	.70	.66	.95	.77	1.05
1897	.45	.45	.55	.65	.57	.70
1898	.51	.45	.60	.60	.62	.60
1899	.95	.50	1.08½	.60	1.29½	.60
1900	.69½	1.00	.78	1.10	.84½	1.25
1901	.64	.60	.79	.70	.89	.80
1902	.59	.60	.66	.70	.77	.75

Charge to vessels in 1902 for unloading iron ore was 19 cents a ton. The wooden vessels that required trimming paid an additional charge of about 3 cents a ton for that service.

Average ore rates for the entire period of twenty years: Escanaba, contract 82 cents, wild 82 cents; Marquette, contract 99 cents, wild 98½ cents. Average for past ten years: Escanaba, contract 63 cents, wild 61 cents; Marquette, contract 78½ cents, wild 73½ cents; Ashland and other ports at the head of Lake Superior, contract 83½ cents, wild 84½ cents.

AVERAGE OF DAILY RATES ON SOFT COAL FROM OHIO PORTS TO CHICAGO, MILWAUKEE, ESCANABA, DULUTH, GREEN BAY AND MANITOWOC.

Year.	Milwaukee, cents.	Escanaba, cents.	Duluth, cents.	Green Bay, cents.	Manitowoc, cents.
1893	.48	.40	.38	.50	.41
1894	.48½	.39	.37½	.49½	.48
1895	.54	.39	.36½	.50	.51
1896	.33½	.27	.29½	.32½	.32
1897	.28½	.29½	.26	.30	.31
1898	.28	.26½	.23	.28½	.28½
1899	.69	.58	.45½	.66½	.67
1900	.45	.40	.40	.45	43½
1901	.49	.46	.38	.48½	.48
1902	.46½	.41½	.34½	.46½	.42
Av. for ten years.	.45	.38½	.35	.44½	.43

Chicago rate about the same as Milwaukee.
Coal of all kinds shipped in net tons and handled without charge to vessel.

AVERAGE OF DAILY LAKE FREIGHT RATES ON HARD COAL FROM BUFFALO TO CHICAGO, MILWAUKEE AND DULUTH DURING TEN YEARS PAST.

Year	Chicago, cents.	Duluth, cents.
1893	49	29
1894	46	25
1895	59	24
1896	36	24
1897	29	26
1898	28	23
1899	73	49½
1900	48	39½
1901	50	38
1902	42	33
Average for ten years	46	31

Rate to Milwaukee practically the same as to Chicago.
Hard coal is net tons and is handled without charge to vessels.

AFFAIRS AT THE HEAD OF THE LAKES.

Duluth, Dec. 17.—It was the intention of the Pittsburg Steamship Co. that at least half its fleet should lay up at this end of the lakes, but the barges were maintained at work on account of the good weather, and it is not probable that more than thirty of the fleet will be here. It is probable that more than seventy-five large lake ships will be in winter quarters at the head of the lakes. Mr. A. B. Wolvin is of the opinion that the head of the lakes is the proper place for the lying up of a very large share of the lake fleet, especially of that major portion of it that is destined to take out ore in the early spring. The fleet of the Pittsburg Steamship Co., together with chartered ships, has delivered at lower lake ports and at Chicago, almost precisely 16,000,000 gross tons of iron ore this year, and there is now enough ore at lower lake receiving docks and at furnaces of the United States Steel Corporation to run them until next July at the earliest. The policy of the Corporation has been to get a large reserve of ore at the lower end in case it might be needed. This reserve will probably be maintained continuously. No announcement can yet be made as to the plans of the Corporation in the matter of the construction of the proposed 550-ft. ships for ore trade.

Grain inspected at the head of the lakes for the season of navigation has amounted in bushels to: Wheat and coarse grains, 44,648,577; seed, 13,640,866; total, 58,289,443. Same period in 1901—wheat and coarse grains, 42,371,675; seed, 12,429,849; total, 54,701,524. The excess in 1902 is therefore 3,587,919 bu. In other items of freight there is a similar excess. In flour the shipments of the year have been 8,456,085 bbls., an excess of 822,130 bbls. over 1901. The tonnage passing through the Portage canal has this year increased about 33 per cent., according to the figures compiled by Capt. D. D. Gaillard.

A notable event of the week has been th first shipment of iron ore from the Mesabi range to St. Louis via the Great Northern and connecting lines. This has been a plan of Mr. Hill's for sometime, and is of far more importance than may be generally supposed. Mr. Hill intends to give such assistance to this traffic as will revive the furnace industry of the St. Louis district, and will give a considerable winter ore tonnage for the Great Northern and its associated Burlington lines.

The most famous piece of land in the iron ranges of Lake Superior, Section 30, on the Vermillion range, has been leased to an exploring syndicate of Duluth, under the name of the Section 30 Co., and the land will be developed at once. Title to the final forty-acre tract of the 320 acres in the dispute was given last week to Laton & Merritt, G. J. Lonstorf and R. H. Fagan, of Duluth, the original locatees, and the exploring company was formed at once. Much is not known of the personnel of the new company. This land covers more than a mile in length and half a mile in width of the ore-bearing formation on the east Vermillion range and is supposed to be very rich. Half the operating mining companies of the United States are said to have been figuring for a lease there and not much under $1,000,000 has been spent in litigation over the land in the past nineteen years and more.

Vermillion range shipments for the year have been as follows: Soudan hard ore 280,000 tons; Chandler 645,000; Pioneer 675,000; Zenith 167,000; Savoy 243,000; Sibley 77,000. This is about 300,000 tons more than the shipments of the preceding year when the same mines, excepting the Sibley, were in operation. Chief increases have been in the Zenith, 107,000 tons, and in the Soudan, 72,000. Improvements are under way at these mines that will probably largely increase their output for the coming year.

The necessary papers were drawn up and signed last week authorizing the Lake Superior Power Co. to divert the water of St. Mary's river into its power canal. The conditions prescribed are that the proposed diversion of water shall not injuriously affect navigation in the waters affected, nor impair or diminish the water levels, or any natural increase thereof in Lake Superior, in the United States ship canal locks or their tributaries.

ALGOMA STEEL CO. GETS RAIL CONTRACT.

The Algoma Steel Co. has received the contract for the steel rails for the first sixty miles of the new Temiskaming railway. The report of the Temiskaming railway commission, awarding the contract to the Algoma Steel Co. is interesting and is as follows:

"It has been decided by the commission, with the approval of the government, to award the contract for the rails for the first sixty miles of the Temiskaming & Northern Ontario railway and five miles of sidings to the Algoma Steel Co., subject to the execution of satisfactory contract forms, the terms of which will be 8,200 tons, 80 lbs. to the yard, which is the style of rail now adopted as the standard by the leading railways on the continent. The price is $32 per ton of 2,240 lbs., f.o.b. cars, North bay, and the deliveries called for are: One-third May 15, one-third June 15 and one-third July 15, 1903. Tenders for the rail requirements of the Temiskaming railway were called for from Messrs. A. G. Kidson & Co. of Glasgow, Scotland; Messrs. Maclure, Ltd., Toronto; the United States Steel Corporation, the Illinois Steel Co., the Dominion Iron & Steel Co., Gerald Lomer, Montreal, (representing German manufacturers); M. & L. Samuel Benjamin & Co., Toronto; James Cooper, Montreal (representing Charles Cammel & Co. of Sheffield, England), and the Algoma Steel Co. No replies were received from Messrs. Kidson & Co., Glasgow, Scotland, and Maclure, Ltd., Toronto The United States Steel Corporation intimated that they would not be in a position to quote, as did also the Illinois Steel Co. of Chicago, and the Dominion Iron & Steel Co. of Sydney, C. B. The last named company stated that, although they expect to make and furnish their new steel rails in the early part of 1903, they did not feel like guaranteeing the deliveries required.

"In calling for tenders the commission required that the price quoted should be duty paid, f.o.b. cars at North bay, as it felt that the foreign manufacturers of rails should assume the risk of the imposition of any import duty on steel rails at the approaching session of parliament. The lowest tender received was from Mr. Lomer of Montreal, representing German manufacturers, but his price was not duty free, his quotation being on the understanding that should a duty be imposed, the commission should pay it. James Cooper of Montreal, representing Charles Cammell & Co., was the next lowest tenderer, but his quotation was on the same basis as Mr. Lomer's. M. & L. Samuel Benjamin & Co. of Toronto were the next lowest tenderers, they agreeing to guarantee no duty if the commission would give them the option of delivery before the dates specified.

"It will, therefore, be seen that, should the Dominion government at the approaching session of parliament, think it proper to give the steel rail manufacturing industry protection approximating in extent that already afforded to other steel and iron manufacturers, viz., $7 per ton, the price at which the contract was awarded the Canadian manufacturers is well within the figure at which steel rails may be imported if such a duty be imposed. The commission took the view that as a question of public policy was involved in placing the order, it would be proper to submit the matter to the government to ascertain whether it would be fully in accord with the disposition of the commission to award the contract to the company operating within the province. This was done, and the reply received from the government was that it would cordially approve of the contract being awarded to the Algoma Steel Co."

ST. LOUIS RIVER WATER POWER

Plans for the development of the St. Louis river water power, recently purchased by the Highland Canal & Power Co., have been completed. The plans for the improvements consist of a dam across the St. Louis river 35 ft. high and the resulting creation of an immense reservoir back of the dam, the construction of a canal 2 miles long, and the creation of another reservoir or forebay and the building of pipe lines to the power house. The last and most important unit of the entire system, the power house, will be constructed on the Minnesota bank of the river, between Thompson and Fond du Lac, 2½ miles west of the latter town.

A large corps of engineers have been surveying the St. Louis rapids, and have just completed the survey. Some of the party are still on the ground finishing up the work. From the surveys thus made, maps are being drawn, showing the course of the canal, the reservoirs, the pipe lines, and all of the necessary details. The entire rapids are about 7 miles long, but the lower end of them will not be used. The "head" that will be secured will be from 350 to 370 ft. The first thing planned is the construction of the dam across the river about 100 ft. north of the Northern Pacific bridge. This dam will be 20 ft. higher than the present one, owned by the St. Louis River Slate Brick Co., and will reach a total height of 35 ft. Its construction will form a huge reservoir over ½ mile square. The island behind the dam will be completely submerged, and all of the low country will be converted into a miniature lake.

From the reservoir a canal 2 miles long will extend down the Minnesota side of the river, crossing under the Northern Pacific railroad, and then running parallel to it. At the end of the canal another reservoir or forebay will be created. This will be rather long and narrow, being ½ mile one way and ⅛ mile the other. These two reservoirs will permit of an almost absolute control of the amount of the water used. After the water leaves the forebay it will be carried down in closed pipes to the power house. In this last descent, closely confined heavy pipes, the necessary power will be secured, with which to run the immense turbines. The power house will lie at the foot of the cliffs beside the bank of the river.

The first installment will be for 30,000 H. P., as there is an immediate demand for that amount, but it is estimated that in the entire system there is a possible 500,000 ten-hour electric horsepower.

The plans for the power house are just being completed. The water will be piped to it in three streams, each capable of developing 10,000 H. P. The wheels, or turbines, as is customary, will be placed as low down as possible, in order to give the water all of the fall that is available. The generators will be 500 H. P. each. The power thus generated will be carried to Duluth and Superior by wire. Transformers will be used, and the electricity given a high voltage, thus rendering the use of extra large wires unnecessary. Substations will be located in Superior and Duluth, where the power will again be transformed into a lower voltage, and distributed by larger wires throughout both cities. It is probable that the main power wire will be run to the head of the lakes back of the Duluth hills, over the company's own property, so that it will have absolute control of it. The plans for the power house are made in such a way that it can be enlarged as needed without any difficulty.

THE 1000-TON BARGE CANAL.

It was stated with some show of authority in eastern newspapers on two or three occasions lately, that Gov. Odell of New York was in favor of the Ontario route for the 1,000-ton barge canal. This, of course, would make a combination of open lake and canal navigation which has been opposed by engineers who have made a study of the subject. Maj. Thomas W. Symons of Buffalo, who is very thoroughly informed on canal improvements, was asked regarding the attitude of the governor and has replied:

"Gov. Odell distinctly disclaims having declared in favor of the Lake Ontario route for the barge canal, or in favor of any other route. In preparing his message he has considered all routes. The governor, in considering the matter, was naturally pleased with the Lake Ontario route on account of its low cost, and it very properly devolved upon the opponents of this route to show him its impracticability and the necessity for the inland route even at a higher cost. This it is believed they have succeeded in doing, as all the canal people of New York and Buffalo, Rochester and Syracuse, are, as far as known, in favor of the inland route, and would not be in favor of having any canal improvement if it were put into Lake Ontario. The Lake Ontario route is not taken very seriously by canal advocates, as it is considered entirely impracticable and it is only advocated by certain people at Oswego who expect that their city will be benefited if the route is made through Lake Ontario. Everything looks very favorable for canal improvement and by an interior route."

Now that they control practically the entire wrecking apparatus of the lakes, officials of the Great Lakes Towing Co. are anxious to have the vessel owners and the representatives of the insurance companies understand that it is not their intention to charge high prices for wrecking work; that they realize the fallacy of inviting competition by exorbitant prices. They claim that by improvement in their equipment, such as has been secured by the building of the wrecking steamer Newman, they will be enabled to carry out jobs of the most expensive kind at prices very much lower than have prevailed under old methods. Two statements recently prepared in the office of the towing company go into detail of costs under the old method in comparison with charges made for the services of the new steam wrecking lighter. Copies of these statements may be had upon application to any of the officials of the towing company. The first case considered is that of the steamer Chili, sunk in collision near Amherstburg, Nov. 24, and from which 30,000 bushels of grain was lightered. The cost of this work by the old method is figured at $4,464, as against $2,203.65 for the new wrecking lighter. Of course the great bulk of the saving is credited to time labor. The second case is that of the steamer Jenks, which was ashore on Lake Huron Nov. 8. It is figured that the job of lightering 1,400 tons of iron ore from this vessel and releasing her would have cost $4.036 under old methods, as against a charge of $2,754.35 for the steam lighter with its modern equipment.

The naval board which recently toured the lakes in quest of a site for a naval training station has made its report. Very sensibly it does not recommend that the training station be established at any of the large cities. The board does not specify any site but recommends that the station be located on Lake Michigan below latitude 43.30 and asks for an appropriation to buy the land and develop the station, leaving the exact locality to be determined later by the board. Secretary Moody has approved the report and recommends immediate action on the part of congress.

CANADIAN EXPERIMENTS IN LIGHTING CHANNEL.

Col. W. P. Anderson, chief engineer of the department of marine and fisheries of Canada, in writing to the Review regarding the experiments undertaken by the department with mixtures of gases in buoys and other forms of illuminants to mark channels says:

We established a generator on our buoy tender on the upper St. Lawrence and produced acetylene which was compressed into the buoys. In some cases a mixture of 25 per cent. of acetylene with 75 per cent. of Pintsch gas was used; in other buoys pure acetylene was tried. In both cases we got much more light than the Pintsch gas alone produced, but we have not yet carried the experiments sufficiently far to be sure how much acetylene is required or whether the acetylene burners will continue indefinitely in operation without attention.

"We are making several experiments with acetylene, but it is too early yet to report results. I think it probable that if this gas is to be used for lighthouse illumination, it will be found more satisfactory to manufacture the gas with one large plant at some central point and distribute it under pressure in convenient tanks, rather than to instal a large number of small generators at individual lighthouse stations.

"With reference to the inquiry respecting the Pelee passage lighthouse illuminant, I beg to advise you that this lighthouse is illuminated with gasoline, vaporized over a Bunsen flame and burned in incandescent Welsbach mantles. The installation was made by the Shafer Air Light Co. under its patent. The light has proved very satisfactory, and is certainly very brilliant. The only doubt in my mind is respecting the advisability of using an illuminant so inflammable as gasoline. I have experimented with it in this particular tower, because the building and the pier on which it stands are both fire-proof. I intend making further experiments with this system of lighting, because it is undoubtedly very effective and very economical. The light at Pelee passage is produced from three burners grouped together within a circle of 3 in. Theoretically, this is not a perfect form of burner and I propose experimenting to see whether we can get a more concentrated light by the use of a single larger mantle.

"The English lighthouse engineers are now vaporizing high-grade petroleum and burning it under a mantle 50 millimeters in diameter. If we can succeed with a single mantle of that size, it should give an exceedingly brilliant and concentrated light."

AROUND THE GREAT LAKES.

The secretary of war has issued a permit to Murray Bros. to construct a dock at St. Ignace.

During the storm of last week a stretch of 1,000 ft. of the Buffalo breakwater settled 15 ft.

The steamer Frank E. Kirby will receive new trim tanks, paddle boxes and decks this winter.

The Cleveland life saving station has closed for the winter. In case of trouble Capt. Motley will have to engage volunteer crews.

It was announced, following the annual meeting of the directors of the Pere Marquette railway in Boston Tuesday, that the company intends to increase its through business across the lakes by adding to its car ferry equipment up to seven boats.

In a race from the head of the lakes to Buffalo between the Western Transit Co.'s liner Troy and Buffalo last week the Buffalo is said to have won by an hour and a half. It is only fair to state, however, that the Troy made a short stop at Detroit for coal.

A large fleet of passenger steamers, mostly big side-wheelers, take to winter quarters at Detroit. Nearly all of the big paddle steamers were built at the works of the Detroit Ship Building Co. and they need repairs almost every winter. This year the fleet numbers about twenty, belonging to the Detroit & Cleveland, Cleveland & Buffalo, Detroit & Buffalo and White Star lines.

Maj. Dan C. Kingman, government engineer stationed at Cleveland, has received authority from the war department to build a tug for his special use. He will use it primarily to facilitate the inspection of work upon the east breakwater. He is also having constructed at Sandusky a sounding barge, 135 ft. long and 25 ft. wide for the purpose of taking soundings during the progress of the breakwater. This barge will be towed by the tug.

Mr. T. J. Dolan, Jr. of Chicago, who is the general secretary and treasurer of the International Brotherhood of Steam Shovel & Dredge Engineers & Cranemen of America, visited Cleveland last week to organize a branch of the brotherhood. Mr. Dolan says that the Brotherhood is growing rapidly along the great lakes and that the organization, which has 1,700 members, is affiliated with the International Longshoremen & Marine Transport Workers' Association.

A Buffalo dispatch says that the prospect is good for a large amount of repair work at the Buffalo dry dock this winter. Among the vessels to be repaired there are the Bransford, Yale, Commodore, Bulgaria, Warner, Mauch Chunk, Zillah, Pope and a number of others. It is understood that the first of the Wolvin boats (canal size) will be launched about Jan. 15. The company is now beginning to get steel in a little more liberal quantities t..an it did three or four months back.

The recent accident to the steamer Malietoa—she struck at Grubb's reef, Lake Erie—may be charged to the removal of numerous aids to navigation before the season had fully closed. The Malietoa is not, however, as seriously damaged as was at first expected. A careful inspection of her water bottom was made by her officers, and the only apparent damage was three or four bent frames in one of the forward compartments. She is only making about half an inch of water per hour in the No. 1 port tank.

Capt. Lansing H. Beach closed contracts last week for dredging and other work in Cheboygan harbor, River Rouge, Saginaw river, Clinton river and Monroe harbor. Capt. Beach has introduced a merit system in these contracts. For every 100 cu. ft. dredged each month beyond the specified amount the contractors are to receive ½ cent. per cubic yard, and by the same token, for every 100 cu. ft. they fall below the specified amount there is to be deducted ½ cent per cubic yard. The purpose of this is to insure steady progress in the work.

TREATY WITH NEWFOUNDLAND.

The fishermen of Gloucester will be in Washington next week to appear before the committee on foreign relations in opposition to the ratification of the Hay-Bond reciprocity treaty with Newfoundland, believing, as they do, that it is a bargain in which Newfoundland gets everything and the fishermen of the United States nothing. Senator Lodge has presented to the senate papers and statistics regarding Gloucester and the New England fisheries which have been printed as a senate document. It is a very interesting one. It gives the facts and figures about the fishing industry of New England, and works in commercial statistics, politics, poetry and pathos. Regarding the treaty itself it says:

"What does Gloucester get by such a treaty? Only this one small thing—the withdrawal of the tonnage tax which Newfoundland imposes, namely, $1.50 per net ton on American fishing vessels that seek Newfoundland ports at certain seasons of the year for the purpose of buying fresh bait of the Newfoundland shore fishermen at localities where we do not have the privilege of fishing on the Newfoundland coast within the three-mile limit. The buying of this bait is a blessing to these shore fishermen. The American fishing vessels that visit such shores are compared to the salt codfish bankers that fish with trawl on the grand banks. They numbered this year thirty-two and probably paid about $4,000 tax to the Newfoundland government for blessing some of her inhabitants by purchasing something that they were very glad to sell. Newfoundland gets everything—our market free for her fish and oil. The catch of Newfoundland codfish in some years amounts to 1,000,000 quintals. With labor there costing not half as much as it does in Gloucester or other New England ports it puts the New England fishers at a great disadvantage."

The treaty itself, which has just been made public, permits the purchase of bait by American fishermen and the privilege of touching and trading, buying and selling fish and oil and procuring supplies in Newfoundland on equal terms with Newfoundland fishermen. It also admits into the United States, free of duty, the products of Newfoundland fisheries, not including fresh codfish, together with the product of Newfoundland mines, and slates from the quarry, untrimmed. On the other hand specified products of the United States are admitted free of duty into Newfoundland and on others the rate of duty is reduced.

Several steamers of the fleet of the American-Hawaiian Steamship Co., plying between New York, San Francisco and Honolulu, have been fitted with tanks for carrying oil. The other steamers are being equipped with apparatus as rapidly as possible. The experiment thus far has proved satisfactory. The Nevadan has already made three round trips with oil as fuel between San Francisco and Honolulu, covering a total distance of 12,500 miles. The consumption was a little more than nine barrels of oil an hour and the average hourly speed was 12.3 knots, which was a knot higher than had ever been made with coal. It was found that 20 per cent. more power was obtained from the new boilers. The supply of steam was regularly kept at 200 lbs. Instead of nine firemen only three are now employed, and as no coal passers are needed there is a saving of twelve men. It was found that a pound of oil would evaporate from 14 to 15 lbs. of water while a pound of coal evaporates less than 10 lbs. These experiments confirm the results of using oil for steam purposes on the Caspian and in other parts of the world. The present prospect is that the use of oil for steam will become very large within the next few years.

George L. Welt, Waldoboro, Me., has just closed a contract for a wooden schooner with William F. Palmer of Boston. She will be 300 ft. over all, 260 ft. on the keel, 45-ft. beam and 25 ft. deep.

OCEAN CURRENTS.

Every method of investigation thus far employed, whether the drift of floating objects, the comparison of the temperature and the specific gravity of specimens drawn from widely distant points or the distribution of animal organisms cohabiting different localities, all lend support to the belief that the vast mass of water near the surface of the sea and to a very considerable depth below the surface, even at a distance of thousands of miles from the continental shores and hence far removed from local or tidal current influence, is in motion. The continuity of this motion in certain broad and well-defined regions, such as the tropics, can not but impress us with the idea that it is in a general way cyclic, that is, that the same water after a lapse of time retraverses approximately the same path. The source of the energy required to set and keep this vast mass in motion has been productive of endless discussion. The attractive force of the moon, the *vis inertia* or lag of the water itself, the difference in temperature and specific gravity of the equational and polar regions, the unequal distribution of atmospheric pressure, each in its turn has been proposed and strenuously advocated as the true and only cause of ocean currents. To the seaman, however, the cause of the ocean currents has always been the winds, since the motion of the waters of the sea takes its origin in the region where the latter attain their maximum constancy, namely, in the region of the trades. The trade winds cover a belt on the earth's surface extending roughly over 50° of latitude from 30° N. to 20° S., including within this range a greater water area than could be included in any other position. Throughout this wide zone the wind blows for 90 per cent. of the time from some point in the eastern semicircle. In the southern hemisphere the trades are somewhat stronger and more constant than in the northern, owing probably to the freedom from interrupting land areas. Over the eastern half of the ocean they extend far higher in latitude than over the western. This is true of both the northern and the southern hemispheres; the northeast trades in the Atlantic during the northern summer often extend far up on the coast of Spain, the southeast trades during the southern summer often extend beyond the Cape of Good Hope. Similar conditions hold for the Pacific. The southeast trades, too, blow well across the equator in the northern hemisphere.

The trade winds, however, are not continuous throughout the entire belt from north to south. Just north of the equator and confined entirely to the northern hemisphere are two elongated triangular areas extending east and west through some fifteen degrees of longitude; in the case of the Atlantic ocean the base of the triangle rests on the coast of Africa; in the case of the Pacific, on the coasts of Central America and Mexico; throughout these areas the trades are absent, their places being taken during a large portion of the year by light, variable winds and calms, during the remainder of the year by winds whose prevailing direction is southwest—the so-called southwest monsoon of the African and American coasts, most apparent during July, August and September.

THE CHARACTER OF THE TRADE WINDS.

Among those who have not sailed in them the impression is general that the trades blow day after day steadily in one direction and with a constant force. This is distinctly not the case. The trade winds are quite as susceptible to variation, and fortunately so, as the winds of higher latitudes. The one thing about them is that, not being subject to the large variations of barometric pressure which characterize higher latitudes, the wind rarely goes round the compass and, indeed, rarely gets out of the eastern semicircle. As an example of their constancy, let us consider the percentage of winds coming from each compass point for a certain region, for instance, the square bounded by the parallels 20°-25° N. and the meridians 50°-55° W., in the heart therefore of the northeast trades in the North Atlantic. The figures are for the month of June and may be regarded as giving the number of hours in each hundred, or approximately, in four days, that the wind may be expected to blow from the given point: Direction and time—N. 1; NNE. 3; NE. 17; ENE. 24; E. 33; ESE. 8; SE. 10; SSE. 4. Other squares show similar variations—some greater, some less.

IMPULSE COMMUNICATED BY THE WINDS TO THE SURFACE WATER.

Let us now examine the effect of such a system of winds in impelling through surface friction the water with which they come in contact. If through any cause a thin layer of liquid is set in motion in its own plane with a given velocity, the layer immediately below it, and with which it is in contact, does not remain at rest, but likewise receives an impetus. This second layer exercises a like influence over the third, the third over the fourth, and so on, the velocity ultimately attained by each successive layer being proportional to its distance from the bottom layer, which is supposed to be at rest. In the case of sea water the rapidity with which this velocity is propagated downward is very slight. It has been calculated, for instance, that a period of 239 years would elapse before a layer at a depth of 50 fathoms would attain a velocity equal to half that at the surface when the surface current is flowing steadily all this time. Such surface currents do not exist, neither do winds capable of producing them exist. The trades, as we have seen, fluctuate from day to day and, indeed, from hour to hour, and the surface currents fluctuate in obedience to them.

It has been stated, however, that the fluctuations of the trades rarely carry them out of the eastern semicircle and that in point of fact 90 per cent. of the winds that blow in the region of the trades do come from that semicircle. There is thus always a westerly component in the motion of the air, coupled with a component which is sometimes northerly, sometimes southerly. For each alteration in the direction of the wind there is a corresponding alteration in the direction of the surface current, the new direction being the resultant of the old direction and the direction which would be imparted to it by the new wind acting alone. These, however, affect only the waters immediately at the surface. Thus, to cite, a specific example, observations at the Adlergrund lightship, in the Baltic sea, have shown that while the water at the surface responds almost immediately to a change in the direction of the wind, the water at the depth of 2½ fathoms does not feel its effects until an interval of twenty-four hours has elapsed. The steady westerly component is then the only one felt in the region of the trades at some little depth below the surface, and this is sufficient to impart to the entire body of water occupying the equatorial regions of the earth, a westerly motion.

It is of some interest to note the velocity imparted to the surface water by winds of a given force. A comparison of a large number (658) of wind and current observations in the equatorial regions gave as the set imparted by a wind of force 4 on the Beaufort scale, corresponding to 20 miles per hour, a current velocity of 15 miles per day. The figures are taken from the meteorological data for nine 10°-squares of the North Atlantic ocean, published by the meteorological committee of the Royal Society.

The system of surface currents produced by such a system of winds as the trades has been experimentally studied, using for this purpose a miniature ocean, the surface of the water being lightly sprinkled with powder in order to render its motion visible. As soon as the artificial wind was brought into action, a drift was created, and the first tendency was for the water to flow from all sides into the rear of the drift. This gradually extended itself in a sheaf-like form, the marginal threads in the fields untouched or only occasionally touched by the air current leaving the main body, first branching out to the right and left, then, reversing their motion, and finally again working around to the rear of the drift. The central portion of the drift followed a right-line course, in close agreement with the direction of the air currents, until a perpendicular obstacle was interposed. Here the drift divided into two streams, each flowing with the same velocity, but having half the cross section.

This experimental system of currents finds its counterpart in nature. Under the northeast trades in the North Atlantic and the southeast trades in the South Atlantic, we find a broad central drift directed toward the shores of America, the drift from the southeast trades extending well into the northern hemisphere, the two uniting some distance off Cape Saint Roque. To the right and to the left of each of these drifts the water fringes off, the direction of the motion is reversed, and the so-called compensating currents manifest themselves. Along the equatorial margin of the two main drifts, under the equatorial belt of calms, these compensating currents unite to form the counter-equatorial current, or Guinea current, reaching a maximum intensity during June, July and August, the months of the southwest monsoon. On the polar margin they either return into the drift or are taken up by the general easterly drift of the higher latitudes.

In the equatorial region of the earth we thus have in either ocean three currents. In the North Atlantic the north equatorial current, due to the northeast trades; in the South Atlantic the south equatorial current, due to the southeast trades; between these two the counter-equatorial current, flowing at all times, but reaching a maximum intensity and covering a maximum area at the time of the southwest monsoon. These first two are westbound, carrying the water toward the shores of America; the third is eastbound carrying toward the shores of Africa. They all suffer a slight displacement with the season, in harmony with the movements of the trades, which oscillate slightly in latitude with the movement of the sun in declination. Also in harmony with the fact that the meteorological equator lies slightly to the north of the geographical equator, the south equatorial currents extends at all seasons well over into the northern hemisphere. Corresponding again

with the fact that the southeast trades exhibit greater constancy and strength than the northeast, the south equatorial current shows higher velocity than the north, the average for the latter amounting to but 13 miles in twenty-four hours, for the former to 27 miles in twenty-four hours. Similar statements hold for the Pacific ocean. But from this point let us limit ourselves to the Atlantic, the currents for which are not only better known, but also probably better developed, being confined to a less extensive area than the Pacific.

In the Atlantic ocean, then, the two drifts unite some distance off Cape Saint Roque, the eastern extremity of South America. A portion of the water is diverted to the southward forming the Brazilian current; the main body flows west-northwest along the coast of South America, some entering the Caribbean sea by way of the passages separating the Windward Islands, the drift through these passages often attaining a velocity of 50 miles a day. The remainder passes to the northward of the islands, forming the Bahama current. In this neighborhood a series of observations by Admiral Irmanger of the Danish navy showed that the westerly drift of the water could still be detected at a depth of 900 meters.

A striking instance of the fluctuations of the surface currents with the winds is shown in the case of the straits separating the Greater Antilles, the Windward, and the Mona passage. From January to April, the months when the northeast trades are most northerly in direction and blow with maximum force, a strong southwesterly set is felt upon entering these passages. As the season advances and the trades weaken, at the same time becoming southeasterly, these currents diminish and change their direction to northwest. Throughout the entire extent of the Caribbean sea the drift is westerly, save that in those portions where resistance to the flow is offered, such as the southern coast of Cuba, return currents manifest themselves. Throughout the Yucatan passage the drift is northwesterly, but here again the influence of the return current is felt, notably under Cape San Antonio, the western extremity of Cuba, where southeasterly sets are frequent. In the Gulf of Mexico observations have thus far failed to reveal any decided set of the surface water.

THE GULF STREAM.

Between the northern coast of Cuba and the Florida reefs starts the most celebrated of all ocean currents, the Gulf Stream. Discovered by Ponce de Leon in 1513, it has from that time been and still is the subject of scientific investigation.

In the gulf stream we have to deal with a current of a nature entirely distinct from those which we have thus far considered. These were all due to the direct action of the wind upon the water, producing a drift. The gulf stream is only indirectly due to this cause, being the overflow of the water heaped up by the trade-wind drift in the Caribbean sea and the Gulf of Mexico. Throughout a considerable portion of its extent, its direction, even at the surface, is independent of the wind or only slightly modified by it. The stream reaches its maximum strength at the point where it emerges from the Bemini straits between the Bahama bank on the east and the coast of Florida on the west. The breadth of the actual current here between Fowey rocks and Gun Cay Light is 38 miles, its average depth 239 fathoms, its average velocity 50 miles in twenty-four hours, although it rises at times to 100 miles. Farther north its breadth increases, and its velocity is correspondingly diminished. The western edge of the stream in its northward course along the coast of the United States follows closely the 100-fathom curve, although the axis of the stream, the line of greatest velocity, lies somewhat farther seaward, its position varying, according to Pillsbury, with the declination of the moon, lying (at Jupiter) 8 miles farther off shore at time of low moon than at time of high. From Jupiter to Hatteras the axis runs at a distance varying from 11 to 20 miles outside the 100-fathom curve. The color of the stream is a perceptibly deeper blue than that of the neighboring sea, this blueness forming one of the standard references of the nautical novelists. The depth of color is due to the higher percentage of salt contained, as compared with the cold green water of higher latitudes, observation having shown that the more salt held in solution by sea water the more intensely blue is its color. Thus even in extratropical latitudes we sometimes observe water of a beautiful blue color, as for instance in the Mediterranean and in other nearly land-locked basins, where the influx of fresher water being more or less impeded, the percentage of salt contained is raised by evaporation above the average.

Another important fact in connection with the gulf stream is its almost tropical temperature, due to the fact that its high velocity enables it to reach the middle latitudes with very little loss of heat. Upon entering its limits, the temperature of the sea water frequently shows a rise of 10° and even 15°. It was this fact that gave to the stream in the later years of the eighteenth century and the earlier years of the nineteenth an importance in the minds of navigators that it no longer possesses. In those days the chronometer, invented by Harrison in 1765, was still an experiment. Instruments were crude and nautical tables often at fault. The result was that the determination of the longitude was largely a matter of guesswork; a vessel after a voyage from the channel to America was often out of her reckoning by degrees instead of by minutes. The idea, first suggested by Benjamin Franklin, that the master of a vessel, by observing the temperature of the surface water, could tell the moment of his entry into the gulf stream, and hence could fix his position to within a few miles, was hailed with delight. The method was published in 1799 by Jonathan Williams in a work lengthily entitled "Thermometrical Navigation, being a series of experiments and observations tending to prove that by ascertaining the relative heat of the sea water from time to time, the passage of a ship through the gulf stream, and from deep water into soundings, may be discovered in time to avoid danger." In this work he makes the patriotic comparison of the gulf stream to a streak of red, white, and blue painted upon the surface of the sea for the guidance of American navigators.

The discovery of the stream is also alleged to have exercised a curious effect upon the commerce of some of our southern cities. In early days, when the only known sailing route was by way of the trades, it was the custom for vessels making the voyage from Europe late in the year to winter and refit at Charleston or Savannah before attempting to reach the more northern ports of Boston and New York. The prevalence of northwesterly gales along the coast during the winter season renders the passage a trying one even to the larger ships and with the better navigation of the present time. The southern cities thus became, to a certain degree, half-way houses on the voyage, greatly to the benefit of their trade. With the aid of a thermometer, however, a vessel once making the stream was enabled to remain within it and to be thus borne along by the current until the desired northing was made, after which she headed up for port. Thus the necessity for making Charleston or Savannah was obviated and the advantage which they had hitherto enjoyed as commercial centers was lost.

From Hatteras the course of the stream leaving the coast bears toward the east-northeast. It ceases to exist as a stream current—that is, as a current which runs independently of the winds—shortly after crossing the fortieth parallel; even previous to that, the current observations in the square bounded by 35°-40° N., 65°-70° W. (off the coast from Hatteras to Sandy Hook) show for September, the month of maximum frequency, but 32 per cent. of the whole number of observations setting northeast—i. e., only 7 per cent. more than 25 per cent., which would be the number if there were no directive influence whatever. In this latitude the gulf stream becomes part and parcel of the general easterly drift which characterizes the waters of the ocean north of 35° in a manner quite analogous to the westerly drift of the tropics and due to the same cause, namely, the prevailing winds, which, however, show none of the persistency of the trades.

The winds of the North Atlantic ocean—as also of the several other oceans the South Atlantic, South Pacific, North Pacific, and the Indian—are governed mainly by the presence of an almost permanent area of high barometer covering the main body of the ocean, around which the winds constantly circulate; the circulation in the northern hemisphere is in the same direction as the hands of a clock; in the southern hemisphere in a contrary direction, or in either hemisphere "with the sun," as it is expressed by sailors. In the North Atlantic the center of this area lies somewhat to the southwest of the Azores. On the southern slope of this barometric area the winds have an easterly direction, the northeast trades; on the northern slope, a westerly. These westerly winds, however, exhibit none of the constancy of the trades, being frequently interrupted by the wind systems proper to the alternate areas of high and low barometer which move across continent and ocean from west to east, and which form the governing feature of our own weather, the wind backing to the southeast with falling pressure, but hauling to northwest with rising, just as in the case of the trades, only to a much less extent. There is, however, a sufficient easterly component remaining to impart to the waters of the sea below the surface a distinct easterly motion, while on the surface itself there is apparently an utter lack of definite direction other than the fact that the direction of the current ordinarily agrees with the direction of the wind. How true this is may be gathered from a comparison of the observed winds and the observed currents for a given area. Take, for instance, the 5° square included between the parallels 40° and 45° N., 30° and 35° W.—about the middle of the Atlantic ocean: The total number of wind observations recorded for the square was 8,898; that of reliable current observations, 719. Dividing each of these up into quadrants and setting the currents under that wind quadrant to which they are due, we have the following percentages:

	NE.	SE.	SW.	NW.
Currents	20	18	31	31
Winds	16	20	36	28

CONSTRUCTION OF CURRENT CHARTS.

For our knowledge of the surface currents of the sea as tabulated in the current charts used by navigators, or the movements of the waters as they actually take place, we were for a long time wholly dependent upon ships' observations. When at sea the position of a vessel at noon of each day is determined by two independent methods. The first of these is known as the position by observation, and as its name implies, means the position of the vessel as found by actual astronomical observation. The second is known as the position by dead reckoning, and is the position as found by reckoning up

the vessel's progress from noon of the previous day, the compass giving the direction, the log the speed. In a majority of cases these two positions fail to agree. The astronomical position is then assumed to be correct, and the difference between them is set down as the current during the intervening twenty-four hours.

Thus let *A* be the position bv observation at noon of a given day; *B'* the position by dead reckoning at noon of the following day, i. e., the position derived from a consideration of the course and distance during the intervening twenty-four hours. Suppose, however, that astronomical observations show that the actual position of the vessel at noon of the second dav is at *B*. In this case *B' B* will be set down in the log as the current experienced during the intervening twenty-four hours. In case no astronomical observations can be obtained, as happens in fog or cloudy weather, the position by dead reckoning has to be adopted as the best obtainable, with the result that if such weather continues for several days in succession, as sometimes happens at certain seasons of the year, the true position of the vessel may differ considerably from the assumed position. To lessen the chance of disaster these current charts have been constructed, giving the results of current observations in the past, and the master of the vessel, by reference to them, is able to profit by the experience of those who have sailed over the same waters in previous years, and to some extent correct his own dead reckoning.

The current charts of the various oceans published by the British admiralty, the charts which are universally employed by navigators, are the result of many thousands of observations taken since 1830. A glance at these charts will make plain the difficulty which confronts the navigator when approaching a dangerous coast, such as that of Newfoundland or of France, and compelled to rely upon his dead reckoning.

For a knowledge of the motions of the water throughout longer periods of time we are forced to depend upon the drift of floating objects, derelicts, wreckage, floating bottles bearing messages, and the like. All these objects are charted on the drift charts of the United States hydrographic office month by month. Two special attempts recently made to study the currents of the sea by this method deserve attention. The first is an effort to obtain a knowledge of the currents in the Arctic ocean. Stout oaken casks, each one numbered and bearing a message, have been distributed by the Philadelphia Geographical Society among the whalers bound for the Arctic ocean by way of Bering sea, who winter in the vicinity of the mouth of Mackenzie river. These casks are to be placed upon the ice as far eastward as circumstances permit, and the expectation is that they will enter the Atlantic ocean either by Davis Strait or Barents sea,* be noticed by passing vessels, and picked up. A letter from Dr. Bryant, the president of the society, states that thirty-five out of the fifty casks have been already sent out, and that in his opinion they may be looked for on the other side of the circumpolar area about a year from the spring of 1902.

The second project is the proposed investigation of the current in the neighborhood of Ushant and Finisterre by means of floating bottles. This has been undertaken by Lloyds, the great firm of ship underwriters, and has probably been suggested by the number of vessels lately lost in that vicinity, owing to the fact that they were out in their reckoning. The bottles, which are of gutta percha, are to be sealed and thrown into the sea by passing vessels, each one containing a label showing the date and the position at which it was cast adrift. They are then supposed to drift ashore and be recovered. The expense involved is considerable. On the bottle it is stated that a reward of five francs will be paid for the return to any of his majesty's consuls—an instance of liberality of expenditure in the acquisition of knowledge which is almost unprecedented.

* That part of the Arctic ocean between Sp tzbergen, Nova Zembla and Greenland.

SHIP YARD NOTES.

The Mira, the wrecked steamer, mention of which has been made in former issues of the Review, has been taken to Cramps, Philadelphia, where she will be rebuilt.

Mr. Arthur Masters of 29 Broadway, New York, is looking for a modern schooner yacht of about 70 ft. water line; also for a 70-ft. water line steam yacht. The vessels must be first class.

Capt. Lucius J. Stevens of Clinton, Conn., is about to let a co.itract for a wooden steamer of the following dimension: Length, 240 ft,; beam, 47 ft.; depth, 22 ft. She will carry 2,300 tons of coal on 24½ ft. draught.

The Baltimore Ship Building & Dry Dock Co. lately launched the second of an order for two steel barges for the New York Weighing Barge & Coaling Co. Both are to be fitted with machinery for weighing coal and hoisting it aboard vessels.

Roach's ship yard at Chester, Pa. is very busy at present. Two large vessels are on the ways—one for the Ocean Steamship Co. of Savannah, Ga., and the other for C. H. Mallory & Co. of New York. They are both about 400 ft. long and 50-ft. beam

The Nilson Yacht Building Co., Baltimore Md., launched the yacht Constant last week for Messrs. Richard P. Hart and Henry Burden of New York. The Constant is 125 ft. long, 20-ft. beam and 7 ft. deep. Her engines will be installed by the Baltimore Dry Dock & Ship Building Co. She will have a Sullivan engine and a Harlan & Hollingsworth boiler.

The Mississippi, new steamship for the Atlantic Transport Co., was launched this week irom the yard of the New York Ship Building Co., Camden, N. J. The Mississippi is a sister ship of the Massachusetts, which was launched on Oct 14. Both vessels are 503 ft. 6 in. over all, 58 ft. 3 in. beam and 43 ft. deep to the shelter deck. They are rigged as four-masters and have two sets of triple-expansion engines and Scotch boilers.

The Marine Construction & Dry Dock Co. of Mariner Harbor, Staten Island, New York, are building six large life boats—four metallic of 26 ft. length, and two wood of 20 ft. length—for equipment of Atlantic transports now building at works of The Maryland Steel Co., Sparrow's Point, Md. They are also building for the Burlee Dry Dock Co., a wooden cargo boat and a whaling boat. They are also installing a Babcock & Wilcox water-tube boiler in their plant, and expect to be fully prepared for building and repairing steel vessels by Jan. 1.

The Fore River Ship & Engine Co., Quincy, Mass., has just laid the keel of a six-masted schooner for a syndicate headed by Capt. John G. Crowley. She will be christened William L. Douglas and will be the second largest sailing vessel to be built in this country. B. B. Crowninshield of Boston is her designer. Her general dimensions will be: Length over all, 339 ft. 6 in.; length on load water line, 306 ft.; beam, 48 ft.; depth 29 ft. 9 in.; load displacement, 7,700 tons. Four steam engines will handle the anchors and rigging and serve the hatches and she will be fitted with powerful steam pumps and steering gear. Her lower masts are to be of hollow steel and her top masts of Oregon pine and she will spread 36,000 sq. ft. of canvas, cut into twenty-two sails.

ADVANTAGES OF AID TO SHIPPING.

Mr. Alexander R. Smith of the New York Maritime Exchange has written a comprehensive argument in favor of ship subsidies in answer to an article in the Portland Oregonian, widely reprinted, which purported to represent, but which really misrepresented, Senator Frye's position on the shipping question. Mr. Smith says:

"The Oregonian claims to find in Senator Frye's appeal for subsidies 'in effect a declaration of the failure of the protective policy,' on the ground, it is pointed out, that 'all materials entering into the manufacture of ships are heavily protected now.' It so happens that all materials entering into the construction of American ships for the foreign trade—the only trade in which the subsidy is sought—are, and for many years have been, free of all duty. This is a fact that the Oregonian needs to be informed of. The ship Dirigo of Maine, built eight or ten years ago, was constructed of foreign steel, imported free of duty. The Oregonian is right, however, in saying that the labor employed in ship building 'has the same protection accorded to other American labor.' And it is precisely here that we find the real reason for the lack of American ship building for the foreign trade—the wages paid to American labor, which are about 50 per cent. higher than the wages paid to British labor in British ship yards. This explains why the cost of an American ship, quite regardless of the cost of the materials entering into her construction, is about 30 per cent. higher than the cost of a similar foreign-built ship. A case in point illustrative of this is the fact that the Atlantic Transport Line, an American corporation owning foreign-built ships and running them under the British flag, nearly two years ago (when the cost of steel was less in the United States than it then was in Great Britain) made contracts with an American and a foreign ship yard simultaneously for the construction of two ships in each yard, identical in every respect. The cost of the British-built ships was $1,429,120 each, and the cost of the American-built ships was $1,846,800 each. In running the American-built ships in competition with foreign-built ships in our foreign trade their owners will be handicapped with an extra annual expense of 15 per cent. for interest, depreciation and insurance, on $427,680 over a similarly built foreign ship, and she will have to earn $64,152 more than the foreign ship in order to pay her owners the same profit that the foreign-built ship pays. The consequence, in the case of the line in question, is that all ships it has ordered since it made the costly experiment instanced above are being built abroad. This, you see, involves a loss to American labor, but subjects the capital so invested to no loss. The latter finds profitable employment in ships of foreign construction, to be sure, but American labor is denied profitable employment. Is it to the interest of capital or of labor in such cases to have the ships built in the United States? The manager of the Atlantic Transport line stated in the columns of the New York Times that he might be compelled to place his American-built ships under a foreign flag in order to be able to run them as cheaply as ships under foreign flags, with which he is obliged to compete in our foreign trade, are run. Who will be injured if this is done—American labor or American capital?

"It must be clear that it is the wages paid to American labor in the ship yards that prevents the building in American ship yards of a large proportion of the shipping required for the carriage of our foreign commerce. If American labor would accept enough less wages than it now receives to enable owners to have ships built in the United States as cheaply as in Great Britain, doubtless they would be built here. But our labor will not accept less—it demands profitable employment—and so the American with capital to invest (he, too, seeking profitable employment for his capital) puts it into foreign-built ships, as Mr. Morgan and his associates are doing. In this last named case we find a demonstration of the willingness of American capital to invest in ships—foreign-built ships, however—and it is to be assumed that this capital, so invested, will be safe and profitably placed. American capital, therefore, is not unemployed because we have no shipping under our own flag, but American labor is. The amount of the subsidy being the sum of the difference in the wages paid here and abroad, the capital invested in a subsidized American-built ship will earn no more than the same capital invested in an unsubsidized foreign-built ship earns. If the subsidy is paid to the American ship owner, he merely pays it out to American labor, and if he don't get the subsidy, he pays out his money to the foreign labor which he employs more cheaply.

"So far from Senator Frye, therefore, endeavoring 'to inject the direct withdrawal of public money from the treasury for handing over to the few millionaire ship builders and ship owners, as the Oregonian charges, he seeks to give employment to American labor in our ship yards, without any abatement of the present rate of wages, by letting the United States government make good, through a subsidy, the difference in the cost of the American-built ship that is due to the higher wages paid to the labor employed in constructing it.

"It should be added that the cost of running a ship under the American flag because of the higher wages paid to its officers and crew than is paid to the officers and crews of the ships of any other nation and because of the greater quantity and the better quality of food served to the men on board of American than is served to the men on foreign ships—as required by the laws of the United States—is fully 30 per cent. greater than the cost of running a competing ship under a foreign flag. And the shipping bill now pending in congress merely provides for the payment by the government of a sum barely equal to the difference in the cost of running and the cost of building an American ship, as compared with the cost of running and building foreign ships. And when American ship owners are asked why they do not have their ships built in the United States and run them under the American flag they tell merely the simple truth when they say that the wages paid to American labor in our ship yards and on board our ships are so much higher than the wages paid in the ship yards and on board of the ships employed by their rivals in our foreign carrying trade that they could not earn a profit if the employed American-built ships and run them under our flag. They say, furthermore, that if the government will make good the difference they will build their ships here and run them under our flag. Now, to whose interest is it to have the ships built here—that of American capital or that of American labor? Who will be benefited? The answer must be obvious that American labor is the interested party and would be the beneficiary, and that so long as we do not build our own ships, but employ our capital in foreign ships, American labor is the loser. American labor does not lose; it is not unemployed. And this explains fully why it is that American ships carry but 8 per cent. of our entire foreign commerce.

"The reason (aside from its economic aspects, which are sufficient in themselves, but which I omit from consideration here) why the United States should make good this difference in the amount of wages paid to American labor, employed in our ship yards and on board of our ships, through the direct and effective agency of a fixed subsidy, is that the United States needs, as a resource of national defense, merchant ships and trained and experienced citizen seamen. The lack of merchant ships and experienced seamen of our own makes us weak upon the sea, where we should be strong, and this weakness imperils our national independence, and may, one day, subject us to humiliation and possibly incalculable losses in blood and treasure. We find, too, that through the agency of subsidies, subventions, navigation and construction bounties and other aids other nations foster and build up and maintain their merchant shipping, and thus are in possession of this indispensable arm of national defense—merchant ships and experienced citizen seamen. And it is largely the vast and valuable commerce of the United States that is seized upon by these subsidized and bountied ships of other nations—these semi-military instruments of national defense—and our very neglect to protect and foster and build up and maintain our own merchant marine intensifies our weakness while contributing to the strength and power and prestige of our rivals.

"For more than a generation American ships upon the seas have been unprotected in their competition with foreign ships, and, while the value of our commerce has increased 500 per cent. during that time, or from $500,000,000 to $2,500,000,000, our shipping engaged in carrying it has diminished 67 per cent., or from 2,500,000 to 800,000 tons. Is this a demonstration of the failure of the protective policy or is it indisputable evidence of the failure of free trade upon the sea in the carriage of the foreign commerce of the United States—so far as the United States is concerned. Senator Frye, therefore, can perform no higher nor greater nor more needed duty than to point out, in season and out of season, the dangerous condition of weakness of the United States upon the seas, and I earnestly join with him in this patriotic task of pointing out our pressing need of a great merchant shipping and trained and experienced seamen of our own as an invaluable arm of our national defense, and the duty of the government to extend its aid to the upbuilding of this shipping for the protection of the nation, and without impairing in the least degree the present high standard of wages paid to American labor."

PROCESS OF BRAZING CAST IRON.

At a meeting of foundrymen in Philadelphia, a few evenings ago, Mr. H. Armor Ward, president of the American Brazing Co. of 223 So. Fifth street, Philadelphia, and 532 West Twenty-second street, New York, explained the newly discovered process of brazing cast iron. In the course of his remarks Mr. Ward said:

The discovery of this process has changed the methods in European foundries with reference to complicated castings, especially in the case of large castings where a flaw or imperfection of any kind involved the relegation of the piece to the scrap pile. The patterns were now cut into two or more parts, so that each was a simple piece to mould, and the several parts that went to make up the whole were brazed together, so that in effect when the brazing operation was complete, the several pieces that went to make up the whole casting were as one entire casting, and the cost of production had been reduced, in that the cost of brazing was very much less than the cost of moulding one large casting. Mr. Ward explained that flaws in castings were eliminated by drilling them out if they were small, and brazing in a plug made to fit the hole. If they were large and in the nature of a crack, and if the crack was wide, a piece of any kind of iron was fitted into the space and brazed into place. If narrow, the crack was cleaned out thoroughly and brazed up. If it was so that it could not be cleaned in this way, the fracture was extended by hammering until the entire break could be reached to clean, even if this involved breaking the piece entirely in two. The cost of the Ferrofix involved was about half a cent per square inch of surface brazed.

In tests made for the government in Berlin at the Stevens' Institute in Hoboken, at the University of California and by the Pennsylvania railroad, it had been demonstrated, he said, that the brazed joint was not only stronger than any portion of the casting of equal section, but that the iron adjacent to the joint had its strength increased perceptibly, the tensile strength being raised from 50 to 200 lbs., and the transverse strength as much as 2,000 lbs. It was believed that this was not due to any action of the chemical on the iron, but was entirely owing to the fact that in cooling down from the brazing heat, this cooling down was much more rapid than when the casting was originally made, the effect on the iron being to increase its strength, by reason of this more rapid cooling.

With the practice in Europe in mind Mr. Ward asserted his belief that the introduction of this brazing process must affect the shop practices as radically as was the case there. As the result of his investigations in Germany, France and Belgium, Mr. Ward stated that in his judgment at least, 75 per cent. of the flaws that ordinarily destroy the value of a casting could be eliminated, and the places made strong and serviceable at a small fraction of the cost of re-moulding, and as one of the banes of the foundrymen's business was the loss accruing from the imperfect castings, and this process seemed to solve the trouble to a very large extent, he hoped the gentlemen present would experiment with the process on such lines as they deemed requisite for adding to the knowledge of its use. Several of the gentlemen present asked the privilege of sending imperfect castings to the shops of the American Brazing Co. for the purpose of noting the results of the work done. Several small pieces were exhibited, but as there were no means of testing the strength of the joint, it could not be determined just how satisfactory the joints were for strength, although to all appearances the pieces were as sound and strong as if they had been moulded perfectly.

Mr. Ward said that the only difficulty encountered in doing large pieces was in cases where the casting was joined in such manner as to prevent free expansion when only a small portion of the casting adjacent to the fracture was heated. As castings of this peculiar character were not as commonly encountered as the other kind, the trouble arising from it was not so serious, he thought, and even in such castings, when the entire piece could be heated more or less, the brazing operation was successful.

"The chief peculiarity of this process of brazing," he continued, "is that it is always perfect when the work is properly done. Its simplicity and cheapness are remarkable in view of the fact that in brazing steel or brass an expert in that art is usually required, in order to insure having a good job, but in Ferrofixing by this process no expert skill is required. The

alignment of the piece is unchanged, the surfaces, whether machined or not, are not disturbed in any way, and after the completion of the brazing operation all that is necessary is to clean off the surplus brass and the piece will be found as sound and true as a perfect casting."

Mr. Ward stated that several manufacturers in Germany were brazing brass heads on steel bolts where conditions would permit of this being done. Brass was required for appearance sake and steel for strength. The practice in the German shops, however, is to pay more attention to the looks of a machine than is the practice here. In answer to inquiries made by several of the gentlemen present, Mr. Ward stated that this process of brazing would fasten any two metals together, excepting possibly, aluminum. They had made no experiments in that direction, but meant to take the matter up just as soon as conditions would permit. His company had been so busy arranging for the introduction of the Ferrofixing process to iron trade that no opportunity had been reached that would allow them to make the aluminum experiments, but they expected to try this class of work in the near future as the demand had been made upon them by several manufacturers and there seemed to be a general desire to know how the trials would come out.

SEES HOPE FOR OUR SHIPPING.

Col. Horace N. Fisher in the Boston Evening Transcript.

Ever since the civil war we have been asking ourselves whether there is not some way to regain our former place on the ocean as a great ship owning nation. We have been accustomed to think that the confederate cruisers, fitted out in British ports, drove our ships under the American flag from the seas, and that their very general transfer to the British flag was a final surrender of our long-held position as a great maritime power. We have seen many attempts and plans for reviving American shipping by subsidies, some of which are likely to be discussed at the approaching session of congress. We should well remember that, in the act of congress for building our new navy, provision was made that our new warships, their armor, machinery and guns, should be built in the United States, though at that time we had neither suitable plants to roll the thick armor plates needed, nor the machinery necessary for building the mighty rifled guns to arm our new ships.

We all know the cry for "free ships" and the alleged necessity of doing away with our navigation laws, so that foreign built ships could be owned and sailed under our flag; and we had it constantly dinned in our ears that steamers had relegated sailing vesels to the back numbers of ocean navigation. The statistics of the world's ocean commerce shows, by averaging twenty years, that imports exceed exports 12 per cent.; that 8 per cent. is paid, over the original cost as freights, and 4 per cent. as commissions to bankers and brokers. Now we know that only about 10 per cent. of our exports and imports are carried under the American flag, and we naturally wish to have our fair share of this valuable "carrying trade."

The question how to regain that share, perhaps 100,000,000 a year, is not the least important for a wise statemanship to solve. No more instructive lesson of the importance of a great merchant marine need be cited than the ease with which Great Britain sent and maintained an army of over 200,000 troops in South Africa. Compare that with our own recent war with Spain, and our weakness in merchant marine becomes patent:—even to send a small army corps to Cuba, we practically exhausted our Atlantic coast of available steamer transportation; and it was only by stripping our Pacific coast of steamers, and by buying steamers wherever we could find them, that we could send troops to the Philippines and keep them supplied. Even today we are officially warned that we have neither a sufficient number of officers nor of men to man our new warships; even with those now in commission, the officers are so few as to be so badly overworked that at least two of them have become demented, and committed suicide because of the strain of the recent manœuvers, while the crews are being constantly depleted by desertions.

I have above mentioned several of the circumstances and arguments relating to the subject which show that the question involved are far and beyond the question of possible freight earnings. Let us, then, look to some of the deeper questions of how we lost our proud position of a great maritime nation, with ships in every port engaged in profitable commerce, and consider how it may be possible to regain our maritime supremacy. A wooden ship suitable for long voyages had to be built very strongly; her timbers were massive, her sides were thick, the timber of the hull represented a thickness of about 2 ft.— taken out of her carrying capacity, and a weight much greater, perhaps double, that of the frames and sides of an iron ship. Hence the carrying capacity of a wooden ship, compared with an iron ship of the same displacement, is greatly reduced by loss of inside space taken up by the timber of the hull and by the excessive weight of her hull. This difference in carrying capacity, of effective tonnage, enables an iron ship to carry that additional equivalent of paying cargo without any increase to cost for running the ship. It is obvious that wooden ships could not compete with iron ships as freight carriers, other things being equal.

At the outbreak of our civil war our tonnage exceeded that of Great Britain; but we had only wooden ships, while Great Britain, owing to her lack of ship timber at home, had entered upon an era of iron ships, which could be built cheaper and carry a larger per cent. of freight-paying cargo than wooden ships of the same displacement, or outside measurement. And, in view of the foregoing facts, it seems beyond a doubt that, even if there had never been a confederate cruiser afloat, it would have been merely a question of time when the iron ships of England would have driven our wooden ships from the world's ocean trade. At that time and for years later, in fact until our congress had provided for rebuilding our navy, this country could not at any time have built iron ships as cheaply as Great Britain; and thus debarred from competing on the ocean, our capital sought employment in building our vast system of railroad transportation. Capital, like water, invariably seeks the level best suited to efficient action; if ship building had paid better than railroad building, we would have increased our ship building; but it did not, even the ships we had could not run at a profit against British iron ships.

Thus, it may well be observed, the decadence of our shipping was due to natural causes; and until such natural causes are reversed so as to be in our favor, our ship building cannot greatly increase. But are those causes, which practically drove our flag from the sea forty years ago, in full force now? The era of iron ships was peculiarly favorable to Great Britain because no country could build iron ships as cheaply as she could; her iron was made from a poor grade of ore, but it was cheap and an increase of material would make up for poorness of quality. But steel has taken the place of iron in ship building, bridge building, railroad construction and almost every kind of constructive work. This is due to a great extent to the fact that Bessemer steel can now be produced quite as cheaply as rolled iron. Moreover steel is much stronger pound for pound, than iron; its tensile strength being twice that of iron, a steel ship can be built proportionately lighter in weight and yet be as strong as an iron ship of the same displacement, and thus be able to carry the difference in weight as paying freight. The steel ship is bound to displace the iron ship as the iron ship displaced the wooden ship.

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All this indicates the incoming era of steel ship building in America, which promises a future of almost unlimited vistas. But while this is most satisfactory to our pride we may yet bring about modifications and economies in ship building so as to cheapen ocean navigation, just as we have cheapened railroad transportations to a point far below anything accomplished in Europe, and thus enter into competition with European navigation on terms decidedly in our favor; and thereby we may regain our former preeminence as a maritime nation, at least as great relatively as we enjoyed fifty years ago.

The established rule of statisticians in calculating the effective tonnage of steamers is to deduct 30 per cent. from their gross tonnage for machinery and coal bunkers; and to reckon three ocean voyages or six short voyages for a steamer against one voyage by a sailing vessel. But it is not entirely the difference of speed at sea which thus doubles and more the effective tonnage of steamers; the rapidity of handling cargo in port is quite as important. The old liner sailing vessel loaded and unloaded by hand, the steamer by donkey engine. The freight steamer finds 10 knots an hour the most profitable rate of speed at sea for either long or short voyage. The Oregon in her famous rush from California to Florida averaged 10 knots; and several of our clipper ships made quite as good an average speed.

If then a type of sailing vesel can be built which will average 10 knots and be supplied with donkey engines for loading and unloading she would prove a dangerous competitor to the steamer as a freight carrier. It would seem that on some such line our country may yet regain, and more than regain, our maritime supremacv. From this general thesis let us look at one of the recent innovations in ship building. Quite recently there has been built at the Fore River company's ship yards at Quincy the seven-masted steel schooner Lawson, perhaps the largest sailing vessel afloat. She measures 5,218 tons, and can carry 8,000 tons of coal; she is classified as A1, for twenty years. Her sail area aggregates 43,000 sq. ft. an acre of canvas; and with her fine lines and great sail area ought to be one of the fastest vessels afloat.

A sailing vessel does not need to be so heavily built as a steamer because there is no vibration of machinery to provide for and no great concentration of weight amidships, as in a steamer, with her ponderous machinery and coal bunkers. Thus the famous greyhounds of the sea, the City of Paris and the Teutonic, have between 19 and 20 per cent. between gross tonnage and displacement of hull, and this does not account for the 30 per cent. allowance for engines and machinery and coal. With the enormous sail area of the Lawson, she ought easily to average 10 knots— as much as a freight steamer; and with her donkey engines she should be able to take in and discharge cargo on the same time as a staemer. Moreover, on a long voyage, a steel schooner of this type ought to make a short trip, as there would be no necessity of coaling, and thus save time necessarily taken by a steamer. It really looks as if we have found a practical way of carrying ocean freight on a basis so cheap and speedy as to defy competition in the ocean-carrying trade, which is the corner stone of maritime supremacy.

George W. Prescott, one of the founders of the Union Iron Works, San Francisco, died last week of heart disease. He went to California from Maine in 1850 and formed the firm of Prescott, Scott & Co. at San Francisco, which later became the Union Iron Works.

It was stated some time ago that the lighthouse board was experimenting with "a cheaper and better light" for gas buoys than the one at present in use but inquiry to Capt. C. T. Hutchins, the naval secretary, elicits the response that no such experiments are being held.

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TRADE NOTES.

The I. & C. Co. make shipment this week from their factory at Chicago Heights of one of their largest special metal sawing machines to the United States government to be used in the Cavite navy yard at Manilla.

The Lake Shore Engine Works, Marquette, Mich., is making improvements to its plant which will add about 60 per cent. to its present capacity. An order has just been placed with Pawling & Harnischfeger of Milwaukee, Wis., for an electric traveling crane which will command the entire casting department.

In perfect consonance with its business, that of iron dealers, the Bourne-Fuller Co.'s calendar reproduces the painting of "The Village Blacksmith." It is in the three-color process and keyed very low in color. The effect is quite satisfactory though it does not arrest attention so quickly as some of the decorative type.

The Ashton Valve Co. Boston, Mass., issue a calendar in photogravure, the subject being that of a child with a dog. It is very soft and well printed. The company says that it will be glad to mail the calendar free to any engineer upon request but requires the engineer to state what plant he has charge of. To others who desire the calendar a charge of 10 cents is made to cover postage.

The Champion Rivet Co. of Cleveland is again sending out Alfred Lenz's "Flight of Time" as the design upon its 1903 calendar. This was one of the striking calendars of 1902. It is doubtful if any calendar surpasses it either in conception or execution. It is a duogravure direct from the wax model and represents a young girl, nude, watching the hands of a dial. As a bit of plastique art it is exquisite.

At the regular meeting of the New England Railroad Club at Pierce hall, Boston, Dec. 9, a paper on "Electrically Driven Shops" was presented by Mr. Robert L. Warner, Boston sales manager of the Westinghouse Electric & Mfg. Co. Mr. Warner's paper was illustrated by a large selection of stereopticon views showing many examples of the application of direct-current and induction motors to the driving of machine shop tools and other apparatus.

Among works in which the Chicago Pneumatic Tool Co. has been installing pneumatic machinery are the Townsend & Downey Ship Building & Repair Co. of New York, Ross Iron Works of Brooklyn, Wm. Cramp & Sons Co. of Philadelphia, Kensington Ship Yard of Philadelphia, American Locomotive Co.'s works at Schenectady, Boston Bridge Works of East Cambridge, Mass., Ricard Boiler & Engine Works of Toledo, and Baldwin Locomotive Works of Philadelphia.

E. F. Houghton & Co., 240-250 West Somerset, Philadelphia, speaks thus of the advantages of the Marck steam trap: "Before the Marck goes into actual service all air and water is expelled from the pipe or apparatus to which it is connected, because the trap is wide open when cold and does not close until steam appears; the Marck can be placed in any position and occupies very small space and therefore is desirable in marine work; the Marck is absolutely automatic and requires no valves except those which control the admission of steam to the apparatus to which the trap is attached."

The United Marine Manufacturing & Supply Co., 100 William street, New York, have issued a slip devoted to their pipe and conduit clamp. No drilling of beams is necessary. The slip says: "It is made of enameled malleable iron or bronze for any size pipe or type of beam. It is simple to install, a screw driver being the only tool necessary. The simplicity and speed in using over old method of drilling makes it a money saver. Should any installation of pipe supported by these clamps require shifting to make room for new lines it can be done quickly at small expense by moving the clamps."

Wm. E. Winant and G. H. Eiswald, both late of the United States navy department, have opened offices in the Kemble building, 15 Whitehall street, New York, and in the Banigan building, Providence, R. I. under the firm name and title of Winant & Eiswald, naval architects, yacht designers and brokers. Mr. Winant was late assistant to Admiral Bowles in the bureau of construction at Washington, and is the designer of the large, full-rigged, auxiliary schoolship Young America, now building at the Perth Amboy Ship Building & Engineering Co.'s yard at Perth Amboy, N. J. In addition to superintending the construction of the Young America, Messrs. Winant & Eiswald have in preparation a large steel, steam yacht for a prominent Providence yachtsman. She will be some 280 ft. over all, 35 ft. beam, 26 ft. depth, molded, and 16 ft. draught. She will be fitted with water-tube boilers and triple-expansion engines of sufficient power to drive her through the water at a very high rate of speed, while her internal arrangements will be very complete. In fact, the latest ideas in yacht construction will be carried out in her construction. She will be used by her owner for visiting all parts of the world, and, as he desires the best that can be obtained, no expense will be spared to make the vessel the very best of her class.

Directors of the Pittsburg & Lake Erie railway have decided to issue the $2,000,000 worth of stock remaining in the treasury. The stock last January was increased from $2,000,000 to $4,000,000 and $2,000,000 was issued. The increase will be issued to make various improvements, including additional tracks.

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WORKS: Ateliers et Chantiers de l'Ermitage, at Saint-Denis (Seine), France.

TELEGRAPHIC ADDRESS: Belleville, Saint-Denis-Sur-Seine.

A MOSELY COMMISSIONER ON AMERICA.

Mr. George N. Barnes, who is an influential member of Mr. Mosely's industrial commission now inspecting industrial conditions in the United States, has written a letter to the Engineer, of London, which is a side light on his observations and is very interesting reading. He says:

"I have been but six days on the American continent, three days having been spent in Canada and three in the United States, and I must therefore write with due reserve, inasmuch as I have covered but a fraction of the ground which it would be necessary to get over before committing myself to a final and reliable judgment in regard to the comparative conditions in this and the old country. But in so far as a record of first impressions may be of service, I gladly offer a few lines.

"America, then, strikes me as a country of vast natural resources, and Americans as a people of flambuoyant, not to say braggart, spirit, determined at all costs to exploit these resources. I write these lines in the open air by the edge of the Niagara Falls, in brilliant sunshine and a temperature of about 60 to 70. The ceaseless roll of the waters, the moving milky-like fringe over the huge rocks, and the clouds of spray from the dark and placid pool below, form a magnificent manifestation of nature calculated to appeal to one's deepest feelings, but to the typical Yankee it represents, I think, only so much horse-power.

"I have already seen the stream of immigrants into Canada, I have seen the black helot here in the States, I note the presence on both sides of the border of large numbers of Italians and French and other Continental outlanders, and I am inclined to think that they are welcomed here only as so much raw human material to be used up without the slightest regard for human rights or obligations. In short, there appears to be here, not one, but several rigid lines of division between classes, and those in the lower strata in the social scale stamped with the seal of racial, as well as economic, inferiority.

"One thing, however, I have noted, somewhat flattering to the Britisher, and that is the respect, and even tenderness, felt towards the 'old country.' Let me give an amusing instance: On reaching my hotel the other night I was told that there had been a caller, and on inquiring as to the identity of the person whose name was inscribed upon the card handed me by the darkey porter, he said he presumed 'the gentleman was from the old country.'

"Great Britain is the 'old country,' and Britishers are for the most part near the top. The first workshop I visited was found to be managed by a man from Manchester, in the second a Scotchman was foreman, and the third was controlled by a Crewe engineer.

"American cities have a spread-out, untidy, and, in some respects, a shoddy appearance. Many of the buildings and all the fencing are of wood, and very uneven in structure and street line. There are also many streets badly paved, and the level crossings of the railways appear unsightly and dangerous. There is a legitimate enterprise, however, which our people might copy with advantage. Let me illustrate. I visited a very large railway shop, and I learnt that the company had decided to rebuild and re-equip. Since that decision had become known, the manager had, he said, been bombarded with catalogues of American machine toolmakers, but he had not heard from a single British maker. He preferred the British tool, he said, and thought it was the best, but he was not going to run after British makers.

"Or, take the Lackawanna company of Buffalo. They are building there—spite of the Steel Trust—a steel plant which is to be, we are told, the most complete in the world. Forty million dollars are being invested a thousand miles from the ore fields at the top of Lake Superior, and some 200 miles from the nearest coal supply. The cost, I may say, is over a pound per ton of ore at Buffalo, where it is expected there will be turned out one-tenth of the whole output of the states.

"In regard to labor conditions and standard of living of engineers, I should say that, on the whole, there is but little difference between this and the old country. Wages are higher, and so is cost of living, and the one appears to vary with the other. In Canada cost is less—and so are wages—than here. In the states wages are, I believe, a little over one shilling per hour, except in the large railway shops, where they run lower; but still this is 50 per cent. higher than at home. But, on the other hand, rent and clothing are much more costly. Here in Niagara a workman's house costs 15s. per week, and an ordinary suit of clothes, which in England would cost £3, will cost from £5 to £6. As to whether cost is on the increase or not, I have not yet had an opportunity to ascertain. The hours of labor of the engineers are about fifty-four to fifty-eight per week, and are tending downwards.

"I have seen but little evidence of that 'strenuous life' of which we have heard so much from the British sensational journalists. The machinist here, so far as I have sampled him, works no harder, and I question if he works so hard, as the Britisher. In fact, it seems to me that the 'strenuous life' is here reserved as the prize of the bottom dog. The power stations are extending and multiplying here about the falls. When works at present in course of erection are complete, the power taken from the river will be equal to 400,000 H. P. We visited one today where there are eleven generators, each of 5,000 H. P. or equal to 55,000 horse. The water is taken from an intake cut at right angles with the river about half a mile above the falls. The turbines are in a pit 135 ft. deep, and are connected with the generators on the ground floor by shafts, each one, with shafting and generator, weighing 64 tons and revolving at 250 revolutions

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per minute. The body of water is 9 ft. diameter and is led into the turbine in such a way as to keep the whole weight in equilibrium. The outlet is through a tunnel into the river just below the falls. Altogether the place is well equipped, but no better than, say, Glasgow power station, in the old country. The difference is that, whereas in Glasgow the power is obtained only after the consumption of coal, here it is had for the taking. There is a fall of 50 ft. per mile in the river above the falls; the falls themselves are about 168 ft. deep. From the point of intake to the outlet there is a difference of 200 ft. in the water level."

OPPOSED TO THE EIGHT HOUR BILL.

Mr. E. S. Cramp, vice president and general manager, Cramp works, Philadelphia, appeared before the senate committee on labor last week and opposed the eight-hour bill. He said that all attempts on the part of unions to unionize the ship yards had failed and that they were now seeking to cripple them by adverse legislation. He also added that the advocates of the bill had failed to produce a single employe who would be affected by the bill, who favored it. He thought a workman should have the privilege of working ten hours so long as the employer was willing to pay him for ten hours' work. He did not believe in paternalism or palm gardens for workingmen. Workmen, he said, should be given the highest wages possible and should be permitted to buy their own palm gardens. Mr. J. H. Mull, assistant manager of Cramps, related a nefarious act committed by members of the International Association of Machinists during the Spanish-American war. He said, that the association was endeavoring to precipitate a strike at the ship yard and in order to embarrass the ship yard as much as possible several of the Cramp workmen, belonging to the association, went on board the battleship Alabama and seriously deranged her machinery, which, had it not been discovered in time, would have crippled the ship after it had gone out to sea. Mr. Mull said that the event was not made public at the time but it was later investigated by the war department and found to be true.

The steel steamer George W. Peavey of the Peavey Steamship Co.'s fleet has had quite a good record for what is practically her first season. She left West Superior on Mar. 30 for Two Harbors for a load of ore, and during the season made twenty-four trips from the head of the lakes to Lake Erie ports. Outside of one cargo of coal she has carried nothing but ore. Altogether she carried 151,409 tons of ore. Not one cent was spent on her during the season for repairs.

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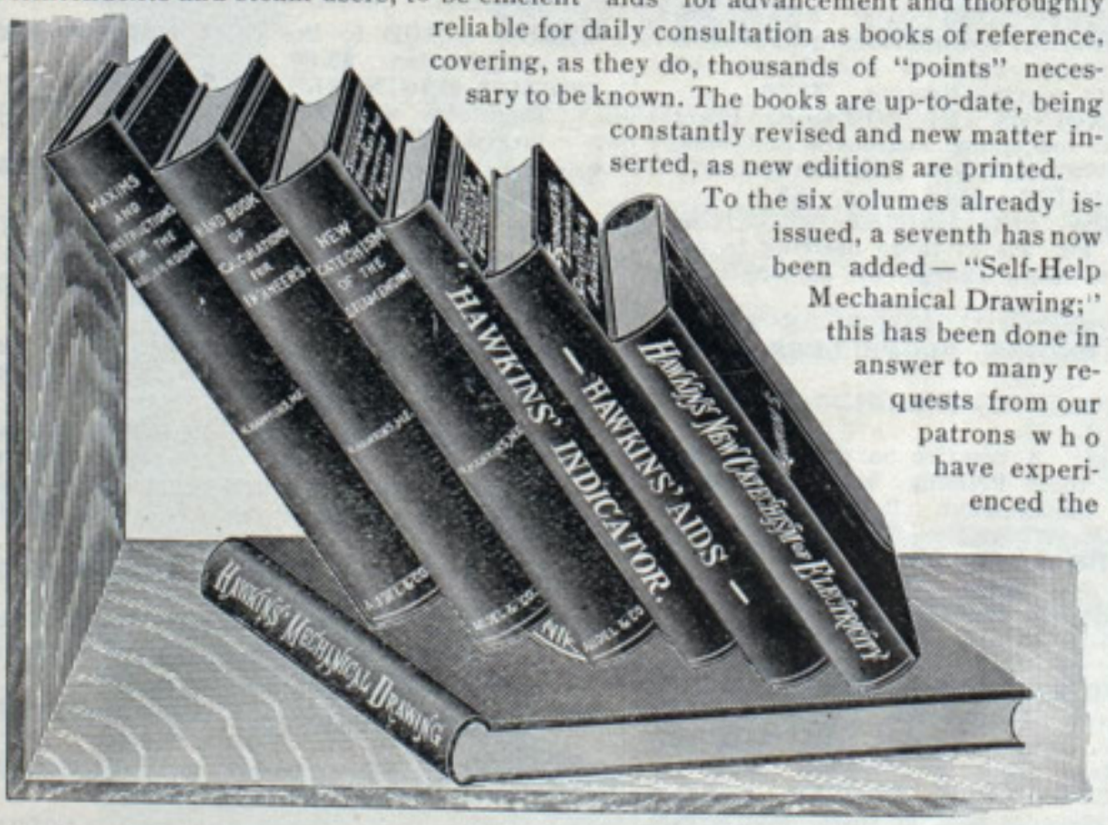

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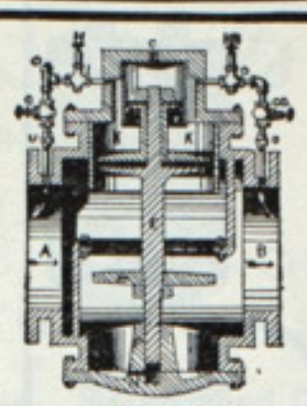

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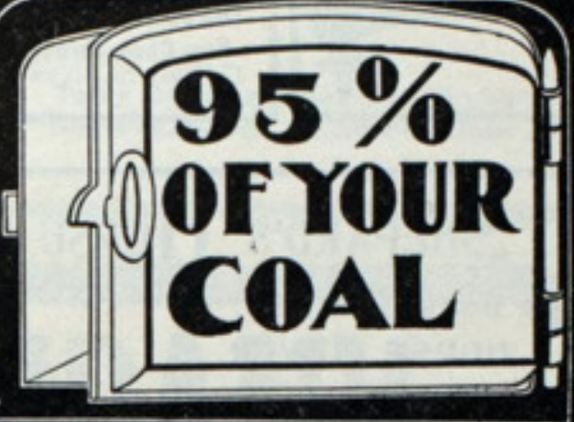

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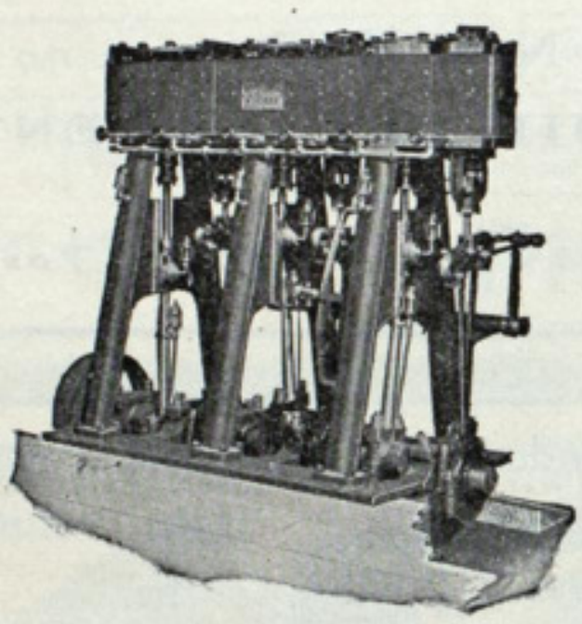

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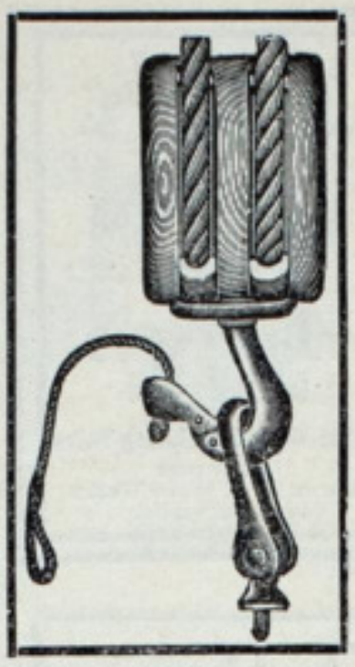

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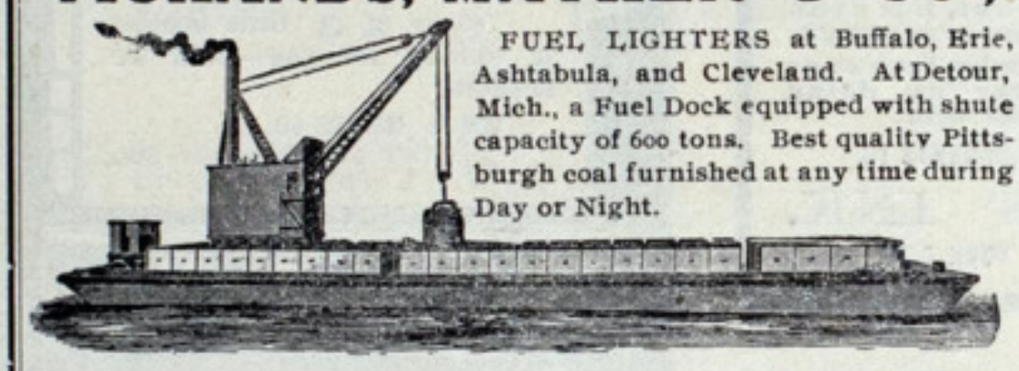

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Two right and left Williams high-speed engines; 13x18-in. cylinders. Have two fly wheels on each engine; in good running order. They develop 100 H. P. each. Length over all, 14 ft. 2 in.; width, 10 ft. 3 in. T. H. Elam, Library Building, St. Paul, Minn. t.f.

High-Pressure Engine For Sale.

One high pressure engine taken from the steamer Eugene C. Hart. Size 22x 25 in. Will be sold at a bargain. Address Hart Steamboat Line. Green Bay, Wis. tf

Wanted Tow Barges.

Wanted to purchase or charter, three one-thousand ton tow barges, in first class condition. State size, condition and price. Union Carbide Co., Sault Ste. Marie, Mich. Dec 18

Steam Barge Faustin For Sale.

For sale steam barge Faustin. Lumber capacity 225,000 ft.; coal 400 tons. Steeple compound engine. Boiler allowed 123 lbs. steam. Boat equipped with electric lights, steam steerer, steam hoisting machinery for handling salt or other freight. For particulars address J. M. Shackett, Marine City, Mich., or J. T. Solon, Toledo, O. Jan 15

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Tug for Sale.

Tug Ada Barrett, 21 gross tons, about 10½ net. Cylinders 13 by 14. About 7-ft. draught. Boat recently rebuilt and in excellent condition. For full particulars address Mitchell & McClure, Duluth, Minn. Jan. 15.

Steamer Crystal for Sale.

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See accompanying index of Advertisers for full addresses of concerns in this directory.

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Goulder, Holding & Masten.....Cleveland.
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Shaw, Warren, Cady & Oakes.....Detroit.
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Marine Construction & D. D. Co., Mariner's Harbor.....S. I N. Y.
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Warrington Iron Works.....Chicago.
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Babcock & Wilcox Co.....New York.
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Detroit Shipbuilding Co.....Detroit.
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Fore River Ship & Engine Co.....Quincy, Mass.
Gas Engine & Power Co.....Morris Heights, N. Y.
Harlan & Hollingsworth Co.....Wilmington, Del.
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Long & Murphy Boiler Co.....Cleveland.
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Marine Iron Works.....Chicago.
Maryland Steel Co.....Sparrow's Point, Md.
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Pusey & Jones Co.....Wilmington, Del.
Risdon Iron Works.....San Francisco.
Roberts Safety Water Tube Boiler Co..New York.
Stirling, The Co.....Chicago.
Superior Ship Building Co.....Superior, Wis.
Taylor Water Tube Boiler Co.....Detroit.
Trigg, Wm. R Co.....Richmond, Va.
Tunnel City Boiler Works .....Port Huron, Mich.
Union Machine & Boiler Co.....Cleveland.
Warrington Iron Works.....Chicago.
Willard, Chas. P. & Co .....Chicago.

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Bourne-Fuller Co.....Cleveland.

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Falls Hollow Staybolt Co. .....Cuyahoga Falls, O.

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Phosphor Bronze Smelting Co. .....Philadelphia.

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Waterbury Brass Co.....New York.

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Farnan Brass Works ..... Cleveland.

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Lake Erie Boiler Works.....Cleveland.
Long & Murphy Boiler Co.....Cleveland.
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Lunkenheimer Co. .....Cincinnati.

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Hutchinson & Co. .....Cleveland.
Insurance Co. of North America.. ... Philadelphia.
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McCurdy, Geo. L. .....Chicago.
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Richardson, W. C. .....Cleveland.
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Hanna, M. A. & Co. .....Cleveland.
Pickands, Mather & Co. .....Cleveland.

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Gas Engine & Power Co. .....New York.
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Marine Iron Works.....Chicago.
Warrington Iron Works .....Chicago.
Willard, Chas. P. .....Chicago.

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Armstrong Cork Co. .....Pittsburg.
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Kahnweiler's Sons, D. .....New York.
Lane & DeGroot .....Long Island City, N. Y.
Marine Construction & D. D Co, Mariner's Harbor,.....S. I. N. Y.

LIGHTS, SIDE AND SIGNAL.

Helvig, H. A. J.....New York.
Page Bros. & Co. .....Boston.
Russell & Watson .....Buffalo.

LOGS.

Walker & Sons, Thomas .....Birmingham, Eng.
Nicholson Ship Log Co. .....Cleveland.
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MACHINISTS.

Chase Machine Co.....Cleveland.
Macbeth Iron Co. .....Cleveland.
Union Machine & Boiler Co. .....Cleveland.
Ward Machine Co.,..... Cleveland.

MACHINE TOOLS (WOOD WORKING).

Atlantic Works, Inc. .....Philadelphia.
Fay & Egan Co., J. A. .....Cincinnati.

MACHINERY, NEW AND SECOND HAND.

Geo. H. Bowler & Co. ..... Cleveland.

MAN-HOLES, SWING DOORS, ETC.

"Long-Arm" System Co. .....Cleveland.

MARINE RAILWAYS, BUILDERS OF

Crandall & Son, H. I. .....East Boston, Mass.

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Fogg, M. W.....New York.

MECHANICAL DRAFT FOR BOILERS.

American Ship Building Co. .....Cleveland
Bloomsburg & Co., H. .....Baltimore, Md.
Buffalo Forge Co. .....Buffalo.
Detroit Ship Building Co. .....Detroit
Steam Boiler Equipment Co. .....New York.
Sturtevant, B. F. Co. .....Boston.

METALLIC PACKING.

Allen, Joseph .....Collingswood, N. J.
Bestosking Packing & Supply Co. .....Boston.
Katzenstein, L. & Co. .....New York.
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METAL POLISH.

Bertram's Oil Polish Co. .....Boston.

MOTORS, GENERATORS—ELECTRIC.

Buffalo Forge Co. .....Buffalo.
Electro-Dynamic Co. .....Philadelphia.
Elwell-Parker Electric Co. .....Cleveland.
Fort Wayne Electric Works .....Fort Wayne, Ind.
General Electric Co. .....Schenectady, N. Y.
"Long-Arm" System Co. .....Cleveland.
Seidler-Miner Electric Co. .....Detroit.
Sturtevant, B. F. Co. .....Boston.
United Machine Mfg & Supply Co.....New York.
Westinghouse Electric & Mfg. Co....Pittsburg, Pa.

NAUTICAL INSTRUMENTS.

Bliss, John & Co. .....New York.
Ritchie, E. S. & Sons .....Brookline, Mass.

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Gaskin, Edward .....Buffalo.
Goodenough, Walter .....New York.
Kidd, Joseph .....Duluth, Minn.
Logan, Robert .....Cleveland.
Mosher, Chas. D. .....New York.
Newman, R. L.....New York.
Sadler, Perkins & Field, ...New York.
See, Horace.....New York.
Wood, W. J. .....Chicago.

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Dixon Crucible Co., Joseph .....Jersey City, N. J.
Standard Oil Co. .....Cleveland.

OIL FILTERS.

Haines Co., W. S. .....Philadelphia.

PACKING.

Allen, Joseph .....Collingswood, N. J.
Bestosking Packing & Supply Co. .....Boston.
Crane Co. .....Chicago.
Jenkins Bros. .....New York.
Katzenstein, L. & Co. .....New York.
United States Metallic Packing Co. ....Philadelphia.

PAINTS.

Baker, Howard H. & Co .....Buffalo.
Berry Bros., Ltd. .....Detroit.
Day's Varnish & Dryer Co. .....Cleveland.
Mohawk Paint & Chemical Co. .....New York.
New Jersey Zinc Co. .....New York.
Topky Brothers,.....Ashtabula.
Upson-Walton Co. .....Cleveland.

PATENT ATTORNEYS.

Thurston & Bates .....Cleveland.

PATTERN SHOP MACHINERY.

Atlantic Works, Inc. .....Philadelphia.
Fay & Egan Co., J. A. .....Cincinnati.

PIPE—BRASS AND COPPER, IRON PIPE SIZE.

Waterbury Brass Co.....New York.

PIPE, WROUGHT IRON.

Bourne-Fuller Co .....Cleveland.
Crane Co .....Chicago.

PIPE, CAST IRON.

Wood & Co., R. D. .....Philadelphia.

PLANING MILL MACHINERY.

Atlantic Works, Inc. .....Philadelphia.
Fay & Egan Co., J. A. .....Cincinnati.

PLATE BENDING AND PLANING MACHINES.

Wood & Co., R. D. .....Philadelphia.

PLUMBING, MARINE.

Mott, J. L., Iron Works .....New York.
Reilly Repair & Supply Co., James....New York.
Sands, Alfred B. & Son .....New York

PNEUMATIC TOOLS.

Chicago Pneumatic Tool Co. .....Chicago.
Q. & C. Co. .....Chicago.

POLISH FOR METALS.

Bertram's Oil Polish Co.....Boston.

POWER DOORS AND HATCHES.

"Long-Arm" System Co. .....Cleveland.

PRESSURE REGULATORS.

Kieley & Mueller .....New York.
Ross Valve Co. .....Troy, N. Y.

BUYERS' DIRECTORY OF THE MARINE TRADE.—Continued.

PROPELLER WHEELS.

American Ship Building Co. .....Cleveland
Atlantic Works .....East Boston, Mass.
Baltimore Ship Building & Dry Dock Co. Baltimore.
Bath Iron Works, Ltd. .....Bath, Me.
Cramp, Wm. & Sons .....Philadelphia.
Detroit Ship Building Co. .....Detroit.
Fore River Ship & Engine Co. .....Quincy, Mass.
Great Lakes Engineering Works ..... Detroit.
Hyde Windlass Co. .....Bath, Me.
Harlan & Hollingsworth Co.....Wilmington, Del.
Jenks Ship Building Co. .....Port Huron, Mich.
Lockwood Mfg. Co. .....East Boston, Mass.
MacKinnon Mfg. Co. .....Bay City, Mich.
Marine Iron Works .....Chicago.
Maryland Steel Co. .....Sparrow's Point, Md.
Milwaukee Dry Dock Co. .....Milwaukee.
Moran Bros. Co. .....Seattle, Wash.
Neafie & Levy Ship & Engine Bldg. Co.....Phila.
Newport News Ship Bldg. Co...Newport News, Va.
Nixon, Lewis .....Elizabeth, N. J.
Phosphor Bronze Smelting Co., Ltd...Philadelphia.
Pusey & Jones Co. .....Wilmington, Del.
Risdon Iron Works .....San Francisco.
Roelker, H. B. .....New York.
Sheriffs Mfg. Co. .....Milwaukee.
Superior Ship Building Co..... Superior, Wis.
Thropp & Sons Co., J. E. .....Trenton, N. J.
Trigg, Wm. R. Co. .....Richmond, Va.
Trout, H. G. .....Buffalo.

PROJECTORS, ELECTRIC.

Elwell-Parker Electric Co. .....Cleveland.
Fort Wayne Electric Works.....Fort Wayne, Ind.
General Electric Co. .....Schenectady, N. Y.
Seidler-Miner Electric Co. .....Detroit.
Westinghouse Electric & Mfg. Co....Pittsburg, Pa

PUMPS FOR VARIOUS PURPOSES

Blake, Geo. F. Mfg. Co. .....New York.
Great Lakes Engineering Works.....Detroit.
Kingsford Foundry & Machine Wks. Oswego, N. Y.
Wood, R. D. & Co. .....Philadelphia.

PUNCHES, RIVETERS, SHEARS.

Chicago Pneumatic Tool Co. .....Chicago.
Wood, R. D. & Co. .....Philadelphia.

REFRIGERATING APPARATUS.

Roelker, H. B. .....New York.

REGISTER FOR CLASSIFICATION OF VESSELS.

Great Lakes Register .....Cleveland.
Record of American & Foreign Shipping.New York.

RELEASING HOOKS FOR DETACHING BOATS.

Standard Automatic Releasing Hook Co. New York.

RIVETS, STEEL, FOR SHIPS AND BOILERS.

Bourne-Fuller Co. .....Cleveland.

RANGES.

Russell & Watson .....Buffalo.

RIVETS—BRASS AND COPPER.

Waterbury Brass Co.....New York.

RUBBER INSULATED WIRES.

Roebling's Sons, Jno. A...New York and Cleveland.

SAFETY VALVES.

American Steam Gauge Co. .....Boston.
Ashton Valve Co. .....Boston.
Lunkenheimer Co. .....Cincinnati.

SAIL MAKERS.

Baker, Howard H. & Co. .....Buffalo.
Upson-Walton Co. .....Cleveland.
Wilson & Silsby .....Boston.

SALVAGE COMPANIES.

See Wrecking Companies.

SCHOOLS—NAUTICAL, ENGINEERING.

Buffalo Com. & Electro-Mechanical Inst...Buffalo.
Chicago Nautical School..... .....Chicago.
Capt. S. W. Gould,.....Cleveland.

SEARCH LIGHTS.

Elwell-Parker Electric Co. .....Cleveland.
Fort Wayne Electric Works.....Fort Wayne, Ind.
General Electric Co. .....Schenectady, N. Y.
Seidler-Miner Electric Co. .....Detroit.
Westinghouse Electric & Mfg. Co....Pittsburg, Pa.

SHEARS.

See Punches, Rivets, and Shears.

SHIP AND BOILER PLATES AND SHAPES.

Bourne-Fuller Co. .....Cleveland.

SHIP BUILDERS.

American Ship Building Co. .....Cleveland.
Atlantic Works .....East Boston, Mass.
Baltimore Ship Building & Dry Dock Co..Baltimore.
Bath Iron Works, Ltd. .....Bath, Me.
Bell Engineering Works, David .....Buffalo.
Buffalo Dry Dock Co. .....Buffalo.
Cramp, Wm. & Sons .....Philadelphia.
Craig Ship Building Co. .....Toledo, O.
Chicago Ship Building Co.....Chicago.
Detroit Ship Building Co. .....Detroit.
Fore River Ship & Engine Co. .....Quincy, Mass.
Great Lakes Engineering Works,..... Detroit.
Harlan & Hollingsworth Co. .....Wilmington, Del.
Jenks Ship Building Co. .....Port Huron, Mich.
Lockwood Mfg. Co. .....East Boston, Mass.
Manitowoc Dry Dock Co..... Manitowoc Wis.
Marine Construction & Dry Dock Co.....
..... Mariner's Harbor, S I N Y
Marine Iron Works .....Chicago.
Maryland Steel Co .....Sparrow's Point, Md.
Milwaukee Dry Dock Co.....Milwaukee.
Moran Bros. Co. .....Seattle, Wash.
Neafie & Levy Ship & Engine Bldg. Co.....Phila.
Newport News Ship Bldg. Co....Newport News, Va.
Nixon, Lewis .....Elizabeth, N. J.
Pusey & Jones Co. .....Wilmington, Del.
Risdon Iron Works .....San Francisco.
Roach's Ship Yard .....Chester, Pa.
Smith & Son, Abram .....Algonac, Mich.
Superior Ship Building Co.....Superior, Wis.
Trigg, Wm. R. Co. .....Richmond, Va.
Warrington Iron Works .....Chicago.
Willard, Chas. P. & Co. .....Chicago.

SHIP CARPENTERS.

Sweeney, Wm. .....Cleveland.

SHIP CHANDLERS.

Baker, Howard H. & Co. .....Buffalo.
Moran Bros. Co. .....Seattle, Wash.
Reilly Repair & Supply Co., James....New York.
Upson-Walton Co. .....Cleveland.

SHIP LANTERNS AND LAMPS.

Helvig, H. A. J.....New York.
Page Bros. & Co.....New York.
Russell & Watson.....Buffalo.

SMOOTH-ON COMPOUND, FOR REPAIRS.

Smooth-On Mfg. Co. .....Jersey City, N. J.

SPARS—LARGE SIZES.

Moran Bros. Co.....Seattle, Wash.

STAYBOLTS, IRON OR STEEL, HOLLOW, OR SOLID.

Falls Hollow Staybolt Co.....Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.

Elwell, Jas. W. & Co.....New York.
Holmes, Samuel.....New York.
King, Rufus S.....New York.
McCarthy, T. R.....Montreal, Can.
Newman, R. L.....New York.
Weeks, F. H.....New York.

STEAMSHIP LINES, PASS. AND FREIGHT.

American Line.....New York.
International Nav. Co.....Philadelphia.
Pere Marquette R. R. & S. S. Line.....Milwaukee.
Red Star Line.....New York.

STEEL CASTINGS.

Seaboard Steel Casting Co.....Chester, Pa.

STEERING APPARATUS.

American Ship Building Co.....Cleveland.
Chase Machine Co. .....Cleveland.
Dake Engine Co ..... Grand Haven, Mich.
Detroit Shipbuilding Co.....Detroit.
Electro-Dynamic Co.....Philadelphia.
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co.....Port Huron, Mich.
Queen City Engineering Co.....Buffalo.
Sheriff Mnfg. Co.....Milwaukee.

STOCKS, BONDS, SECURITIES.

Brown, W. W.....Cleveland.
Fahey & Co.....Cleveland.

SUBMARINE DIVING APPARATUS

Morse & Son, A. J.....Boston.
Schrader's Son, A.....New York.

SURVEYORS, MARINE.

Goodenough, Walter.....New York.
Gaskin, Edward.....Buffalo.
Newman, R. L.....New York.
See, Horace.....New York.
Wood, W. J.....Chicago.

TESTS OF MATERIAL.

Hunt, Robert W. & Co.....Chicago.
Pittsburg Testing Laboratory, Ltd.....Pittsburg.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.

Chicago Pneumatic Tool Co.....Chicago.
Q. & C. Co.....Chicago.
Watson-Stillman Co.....New York.
Wood, R. D. & Co.....Philadelphia.

TOOLS, WOOD WORKING.

Atlantic Works, Inc.....Philadelphia.
Fay & Egan Co., J. A.....Cincinnati.

TOWING MACHINES.

American Ship Windlass Co.....Providence, R. I.
Chase Machine Co.....Cleveland.

TOWING COMPANIES.

Donnelly Salvage & Wrecking Co....Kingston, Ont.
Lake Shore Stone Co.....Milwaukee.
Midland Towing & Wrecking Co., Ltd.Midland, Ont.
Sincennes-McNaughton Line, Ltd....Montreal, Can.

TRAPS, STEAM.

Haines Co., Wm. S.....Philadelphia.
Kieley & Mueller.....New York.

TRUCKS.

Boston & Lockport Block Co..... .....Boston.

TUBING, SEAMLESS.

Benedict & Burnham Mnfg. Co....Waterbury, Conn.
National Tube Co.....Pittsburg.
Waterbury Brass Co.....New York.

VALVES, STEAM SPECIALTIES, ETC.

American Steam Gauge Co. .....Boston.
Ashton Valve Co. .....Boston.
Crane Co. .....Chicago.
Farnan Brass Works..... ..... Cleveland.
Jenkins Bros.....New York.
Kieley & Mueller.....New York.
Lunkenheimer Co.....Cincinnati.
Ross Valve Co. .....Troy, N. Y.

VALVES FOR WATER AND GAS.

Wood & Co., R. D.....Philadelphia.
Ross Valve Co. .....Troy, N. Y.

VARNISHES.

Berry Brothers, Ltd.....Detroit.
Day's Varnish & Dryer Co. .....Cleveland.
New Jersey Zinc Co.....New York.
Also Ship Chandlers.

VESSEL AND FREIGHT AGENTS.

Boland, John J.....Buffalo.
Brown & Co.....Buffalo.
Brown, W. W.....Cleveland.
Dunham, R J..... .....Chicago.
Elwell, Jas. W. & Co.....New York.
Elphicke, C. W & Co.....Chicago.
Hall & Root.....Buffalo.
Hawgood & Co., W. A.....Cleveland.
Holmes, Samuel.....New York.
Hutchinson & Co.....Cleveland.
King, Rufus S.....New York.
McCarthy, T. R.....Montreal.
Newman, R. L.....New York.
Mitchell & Co.....Cleveland.
Richardson, W. C.....Cleveland.
Sullivan, D. & Co.....Chicago.
Weeks, F. H.....New York.

VENTILATING APPARATUS FOR SHIPS.

Buffalo Forge Co. .....Buffalo.
Sturtevant, B. F. Co.....Boston.

WIRE—BRASS AND COPPER.

Waterbury Brass Co.....New York.

WIRE ROPE AND WIRE ROPE FITTINGS.

Baker, H. H. & Co.....Buffalo.
DeGrauw, Aymar & Co. .....New York
Roebling's Sons John A....New York and Cleveland.
Upson-Walton Co.....Cleveland.

WHISTLES, STEAM.

American Steam Gauge Co. .....Boston.
Ashton Valve Co. .....Boston.
Farnan Brass Works..... .....Cleveland.
Lunkenheimer Co.....Cincinnati.

WHITE METAL—SHEETS, RODS AND WIRE.

Waterbury Brass Co.....New York.

WINDLASSES.

American Ship Windlass Co.....Providence, R. I.
American Ship Building Co. .....Cleveland
Hyde Windlass Co.....Bath, Me.
Jenks Ship Building Co.....Port Huron, Mich.

WINCHES.

American Ship Windlass Co.....Providence, R. I.
Hyde Windlass Co.....Bath, Me.

WOOD WORKING MACHINERY.

Atlantic Works, Inc.....Philadelphia.
Fay & Egan Co., J. A.....Cincinnati.

WRECKING AND SALVAGE COMPANIES.

Cuyahoga Contracting Co.....Cleveland.
Donnelly Salvage & Wrecking Co....Kingston, Ont.
Lake Shore Stone Co.....Milwaukee.
Midland Towing & Wrecking Co., Ltd.Midland, Ont.

YACHT SAILS, FITTINGS, HARDWARE, ETC.

Wilson & Silsby.....Boston.

YACHT AND BOAT BUILDERS.

Bell Engineering Works, David .....Buffalo.
Drein, Thos. & Son.....Wilmington, Del.
Gas Engine & Power Co..... New York.
Lane & DeGroot.....Long Island City, N. Y.
Marine Construction & Dry Dock Co. ...New York.
Marine Iron Works.....Chicago.
Truscott Boat Mfg. Co. .....St. Joseph, Mich.
Warrington Iron Works.....Chicago.
Williard, Chas. P. & Co.....Chicago.

YAWLS.

Drein, Thos. & Son.....Wilmington, Del.
Lane & DeGroot.....Long Island City, N. Y.

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Wrecking, Towing and Contracting

LAKE SHORE STONE CO.

—GENERAL OFFICE.—

515 Herman Bldg. **Milwaukee, Wis.**

Milwaukee Telephone, Main 1319. Quarry Telephone, "Lake Church," Wis.

Marine property consists of powerful tug Kate Williams. Entirely rebuilt; 164 gross tons.

Large scows Swift and Klondyke each equipped with strong derricks and hoisting engines.

Steamer Hennepin entirely rebuilt.

Owners or Masters requiring wrecking outfit, wire General Office in Milwaukee or telephone Quarry Office, "Lake Church," Wis.

This company produces Crib, Rip-rap and Crushed Stone for Harbor Work. Capacity of plant 4,000 tons per day. Most modern facilities for handling all kinds of stone for all classes of Government or private contracts.

LAKE SHORE & MICHIGAN SOUTHERN RY.

Eastward.	Arrive from West	Depart East.
No. 18, Southwestern Lim	.....	1:50am
No. 22, Lake Shore L m...	*2:15am	*2:20am
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No. 28, N Y & Bost Ex ..	*7:40am	*8:00am
No. 40, Toledo & Buff Ac.	†10:00am	†10:40am
No. 32, Fast Mail	*11:25am	*11:30am
No. 44, Ac via Sandusky..	†1:40pm	.. ....
No. 46, Southwestern Ex.	....	*3:00pm
No. 6, Lim Fast Mail....	*5:40pm	*5:45pm
No. 26, 20th Cent L m. ...	*7:40pm	*7:43pm
No. 10, C., N Y & B Sp....	*7:30pm	*7:50pm
No. 16 New Eng Ex	*10:30pm	*10:35pm
No. 2, Day Express.	†9:10pm	†9 25pm
No. 126, Norwalk Accom.	†7:50am	.....
No. 106, Conneaut Accom	....	†4:30pm

Westward.	Arrive from East.	Depart West.
No. 25, 20th Cent Lim.....	*2:27am	*2:30am
No. 11, Southwestern Lim	*3:25am	....
No. 15, Bost & Chi Sp.....	*3:10am	*3:15am
No. 43, Fast Mail	*4:35pm	*4:4 pm
No. 7, Day Express.	.....	†6:10am
No. 19, Lake Shore Lim..	*7:15am	*7:20 m
No. 23, Western Express.	*10:30am	*10:35am
No. 33, Southern Express	*12:25pm	....
No. 133, Cleve & Det Ex..	....	*12:45pm
No. 47, Accomodation.....	†11.2:am	†1:00pm
No. 141, Sandusky Accom.	.....	†1:10pm
No. 127, Norwalk Accom..	.....	†5:10pm
No. 37 Pacific Express...	*7:00pm	*7:2 pm
No. 2, Fast Mail Lim.....	*10:50pm	*10:55pm
No. 115, Conneaut Accom.	*8:30am	.....

*Daily. †Except Sunday.

Trains Nos. 23, 28 and 37 run via Erie Station.

City Ticket Office, 237 Superior St.

WILLIAM L. BROWN, President. B. W. WELLS, Vice-Pres. O. R. SINCLAIR, Sec'y & Treas. ALFRED G. SMITH, Gen'l Supt.

CHICAGO SHIP BUILDING COMPANY,

LONG DISTANCE TELEPHONES.
Ship Yard and Dry Dock Office, "South Chicago 40."
Chicago Office, 1125 Rookery, "Harrison," 12.7.

Steel Ship Builders and Dry Dock Proprietors.

Dry Dock and Yards: 101st St. and Calumet River, - - - - CHICAGO, ILL.

MILWAUKEE DRY DOCK COMPANY

MILWAUKEE, WISCONSIN

SHIP REPAIRS

OF ALL KINDS

Two Ship Yards offer every Facility for the Repair of both Steel and Wooden Vessels

South Yard Dock....
is 450 ft. long on keel blocks; 460 feet over all; 56 feet width of gate, and 16 feet over sill.

West Yard Dock....
312 feet on keel blocks; 45 feet width of gate, and 12 feet over sill.

RUDDER PIT IN EACH DOCK.
ELECTRIC LIGHTS FOR NIGHT WORK.

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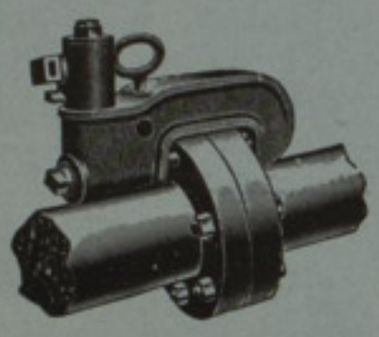

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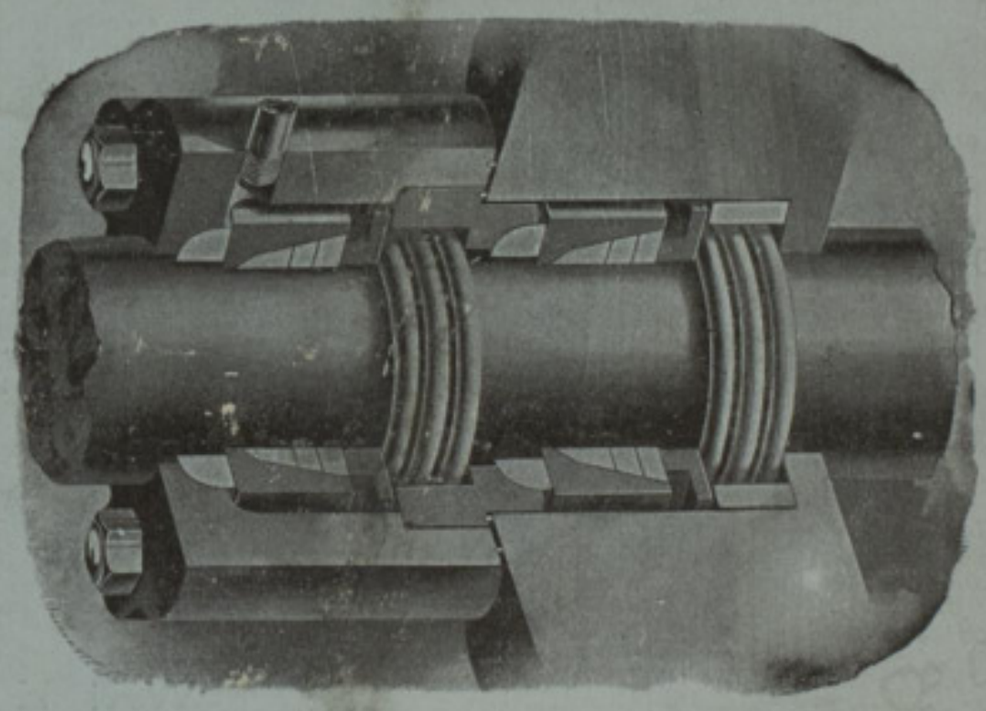

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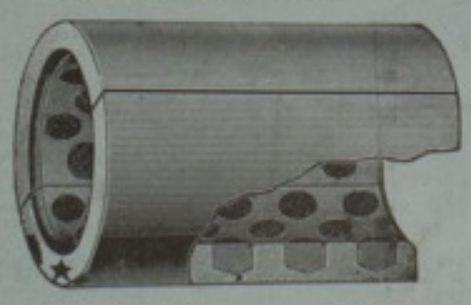

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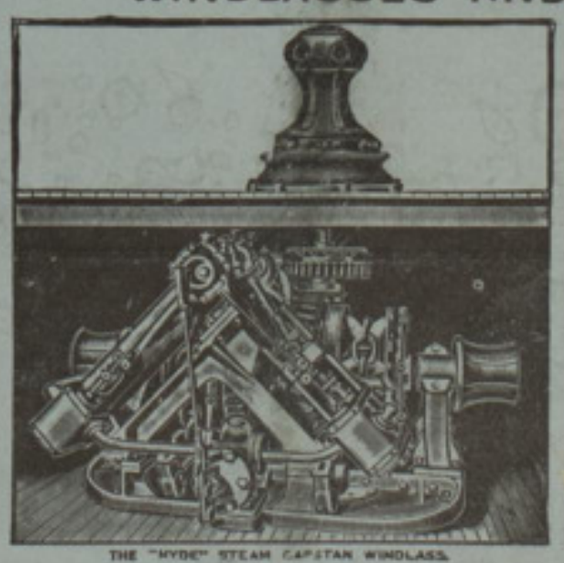

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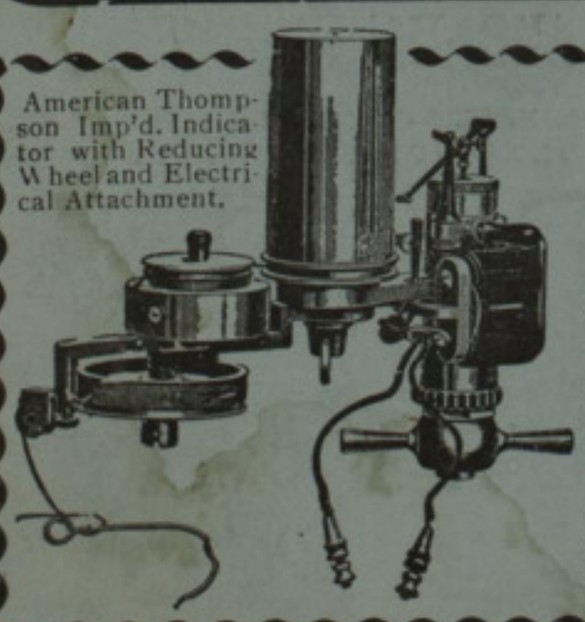

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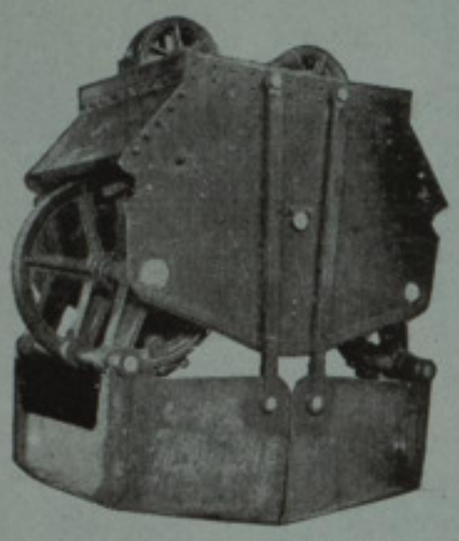

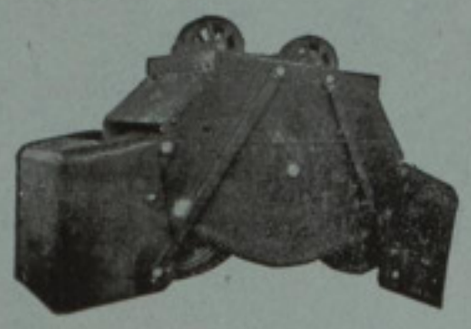

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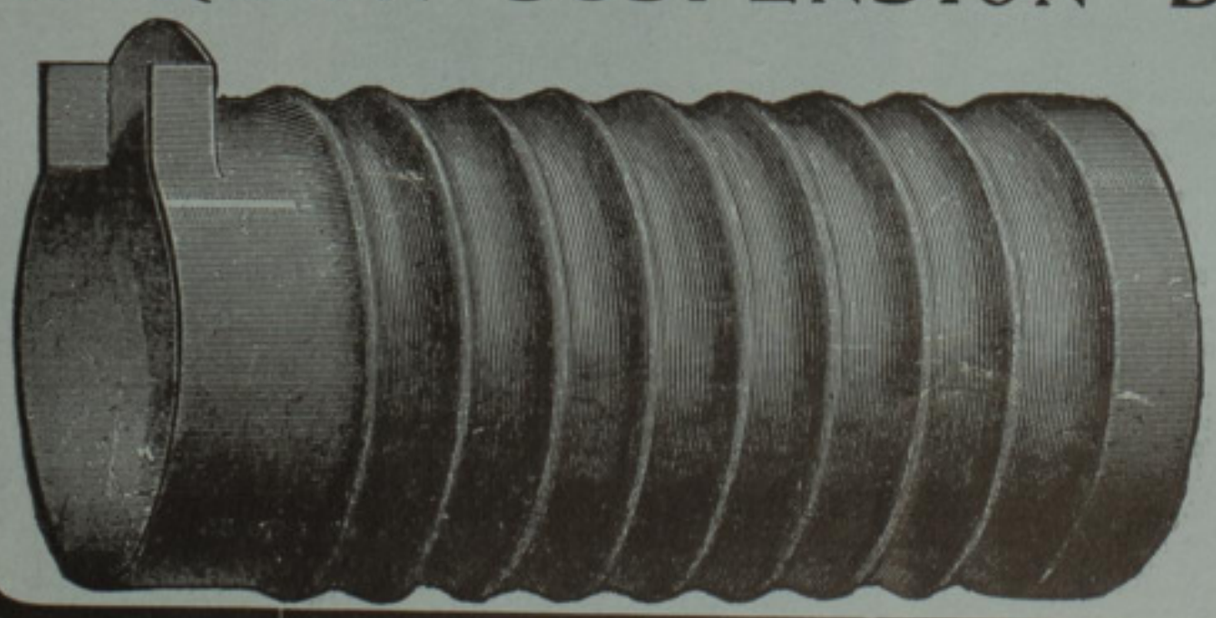

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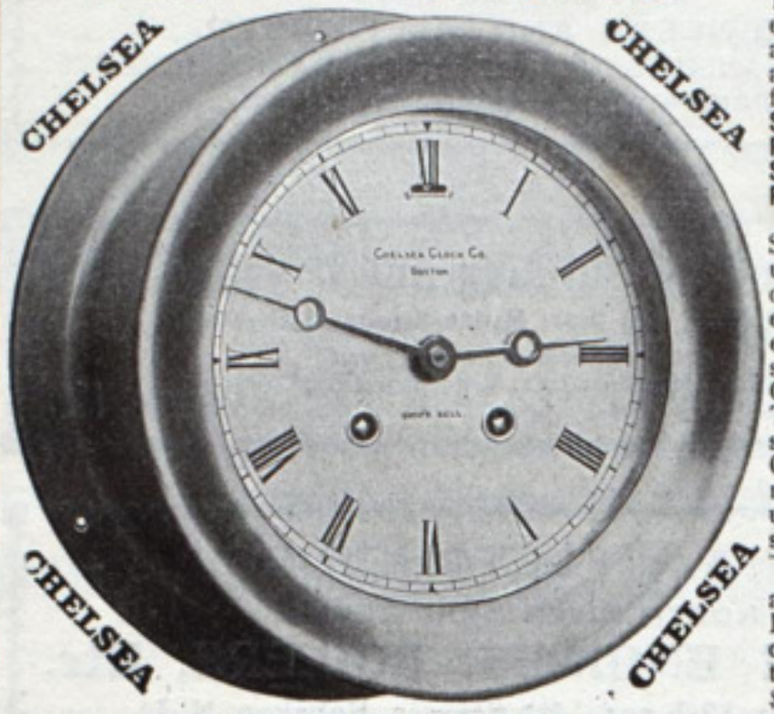

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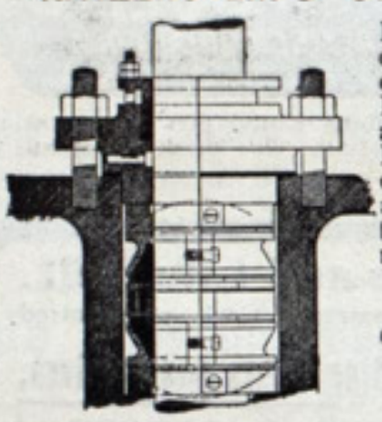

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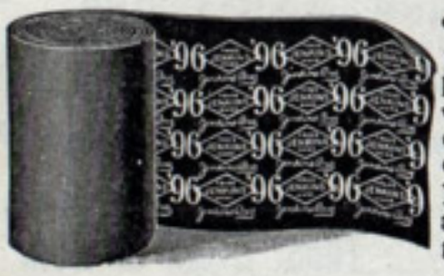

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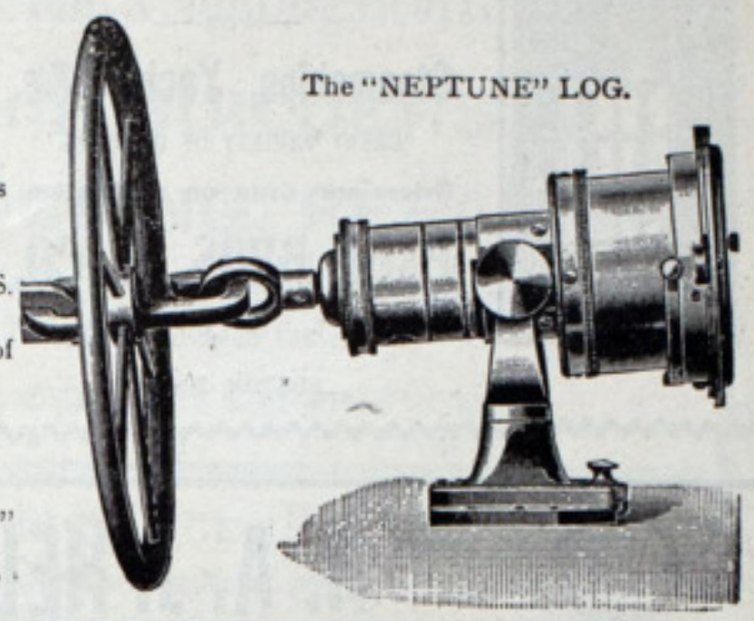

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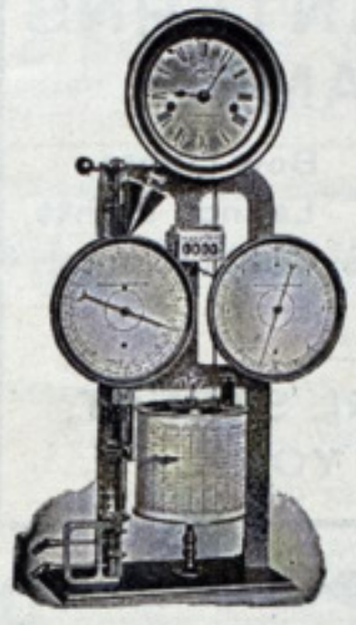

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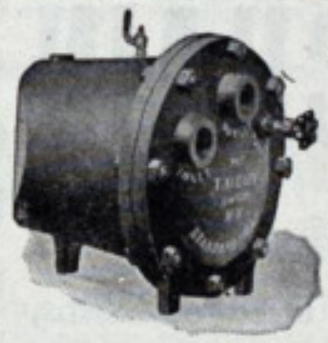

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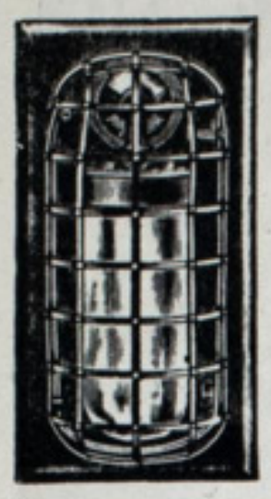

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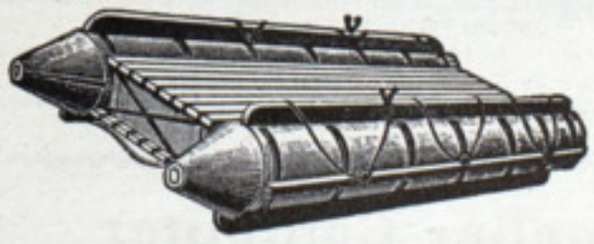

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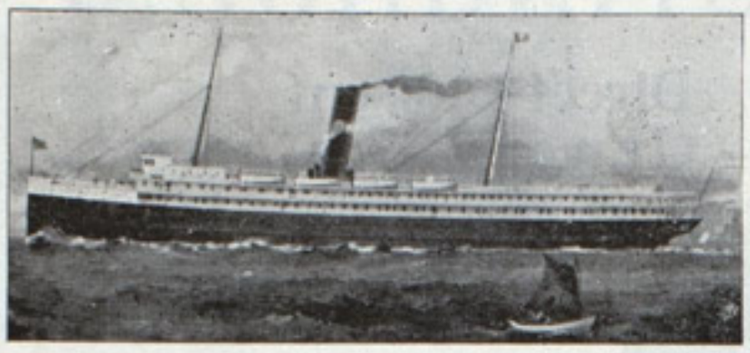

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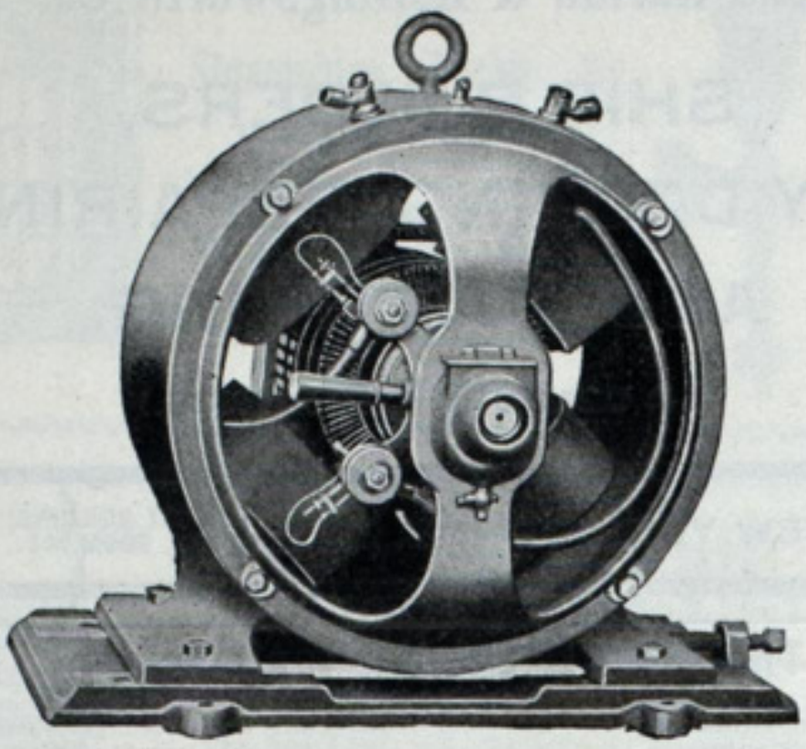

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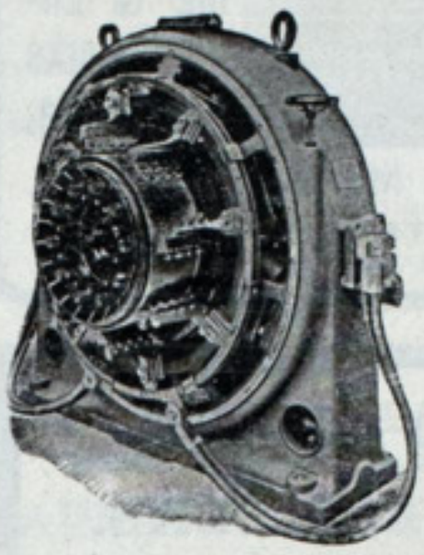

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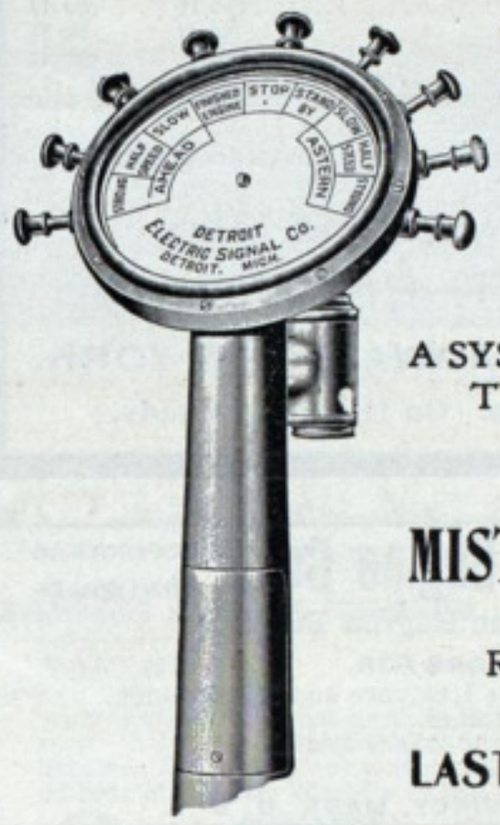

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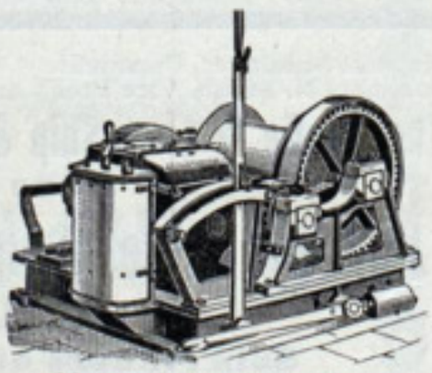

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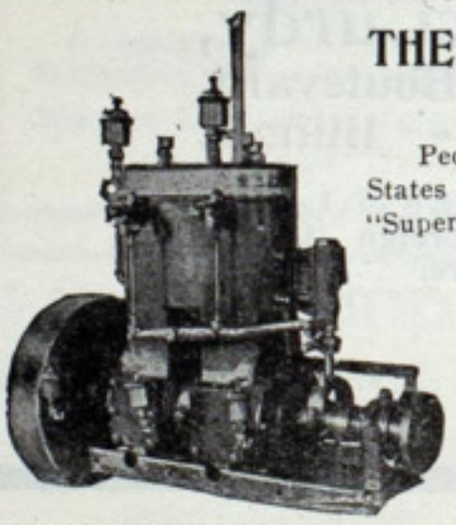

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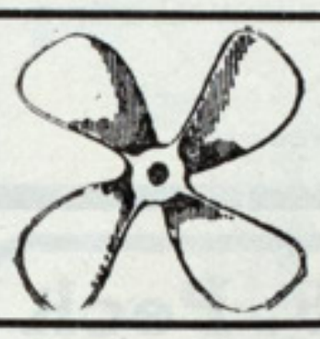

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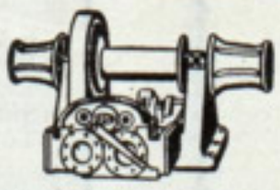

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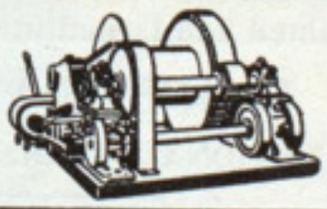

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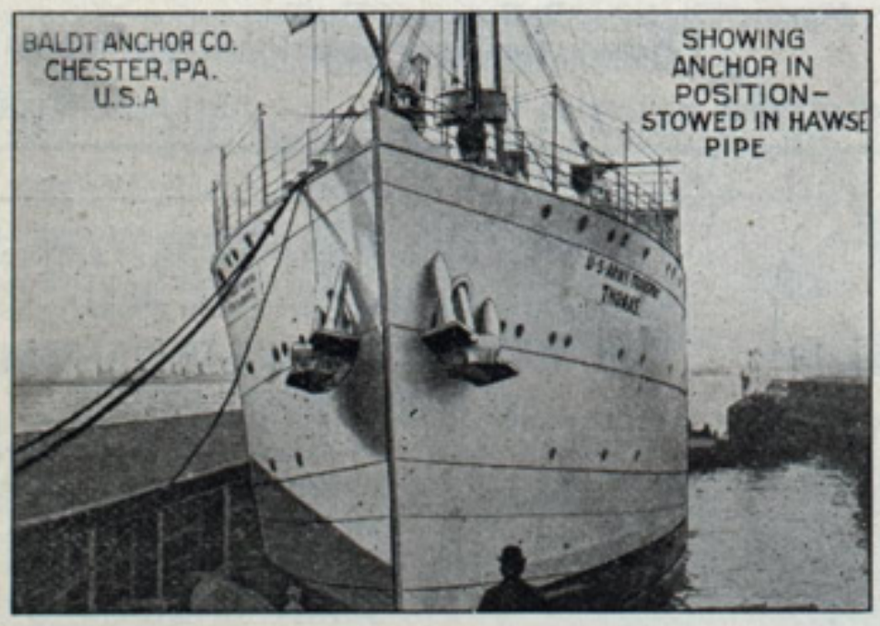

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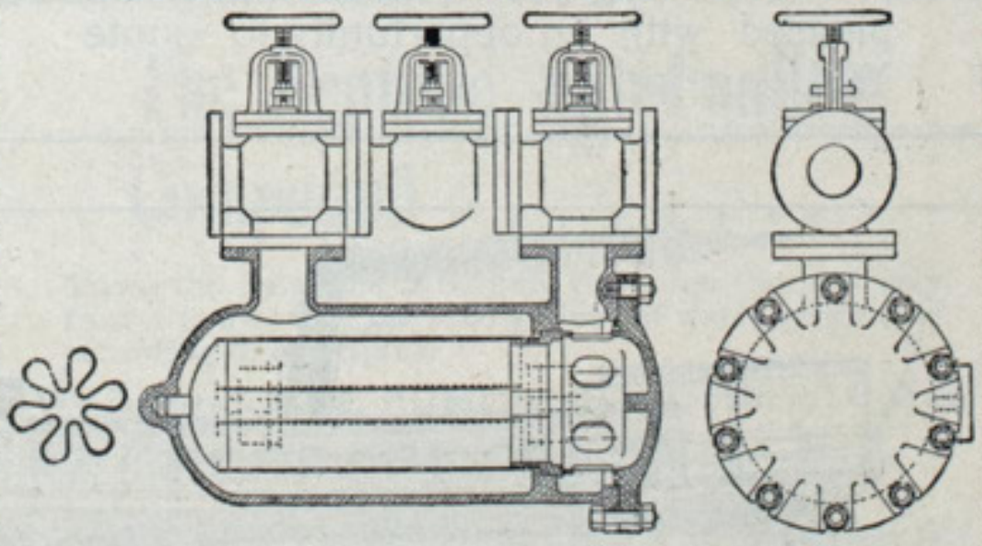

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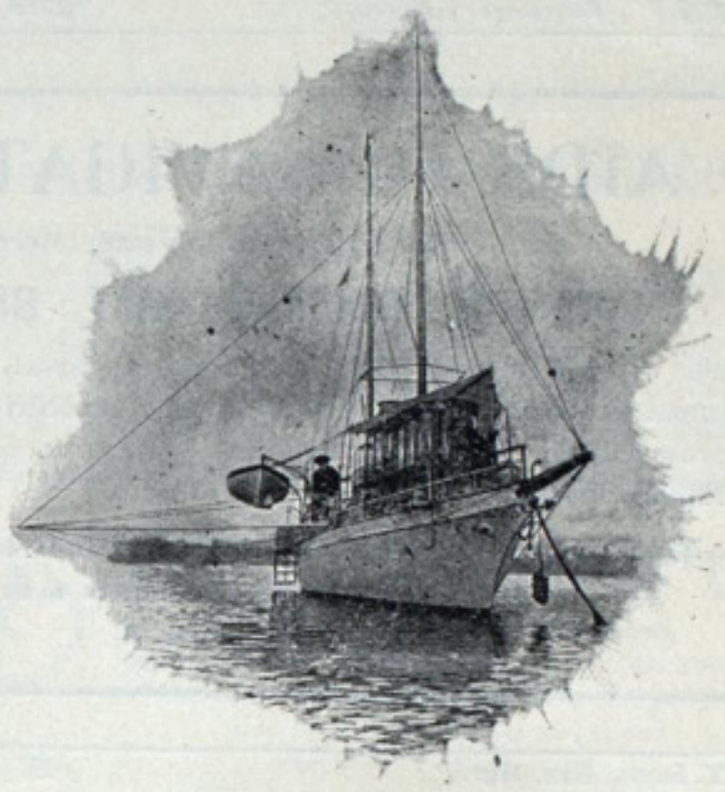

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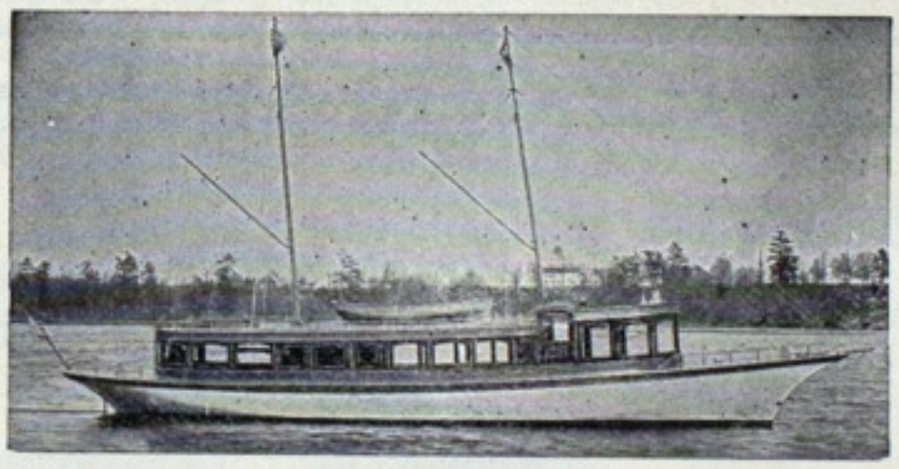

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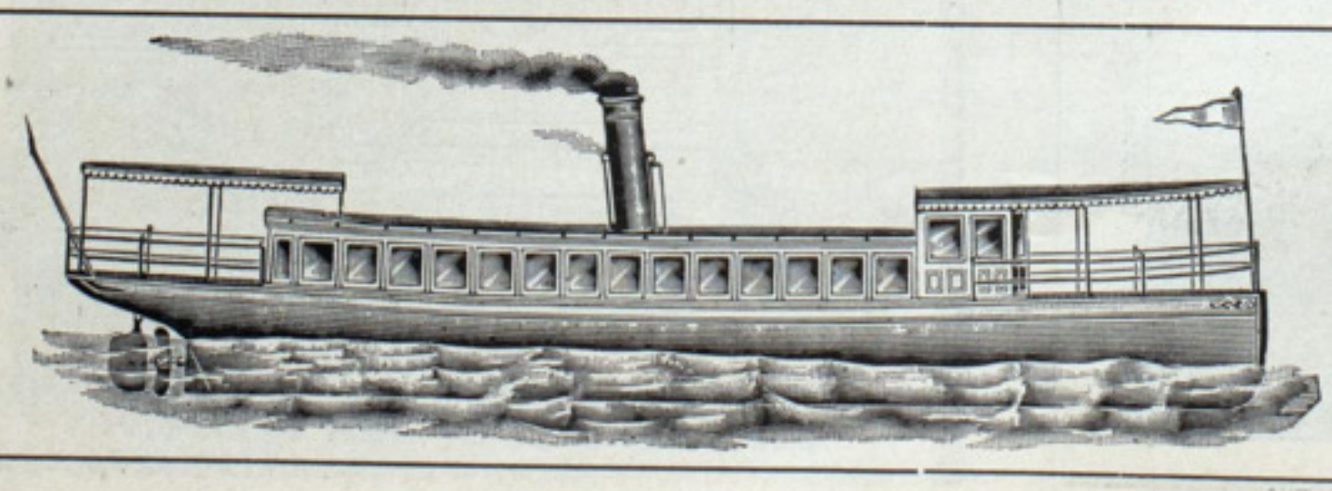

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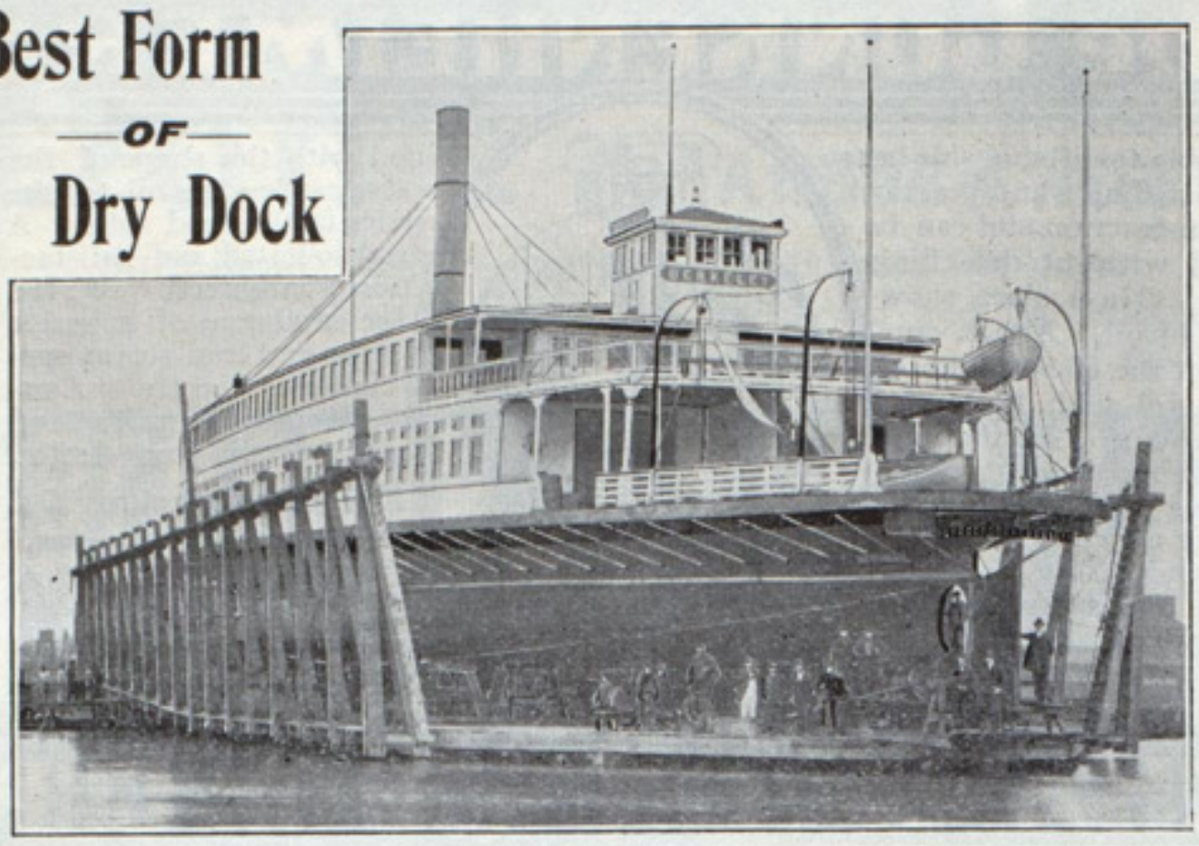

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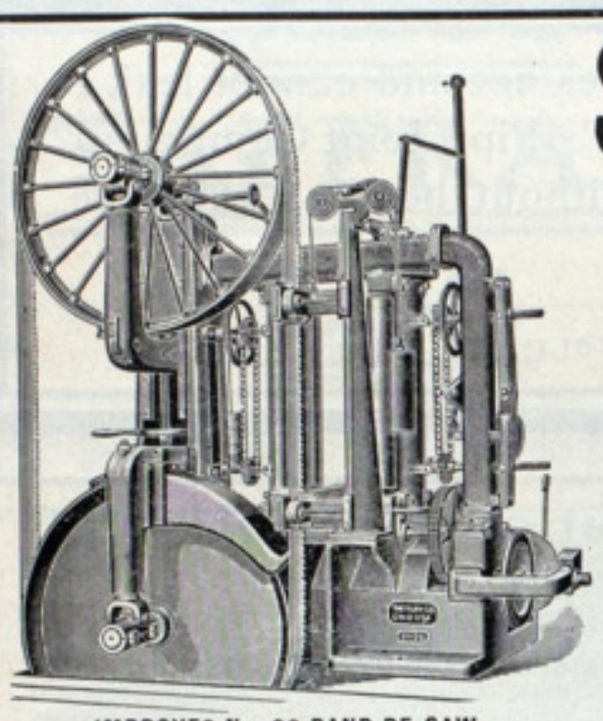

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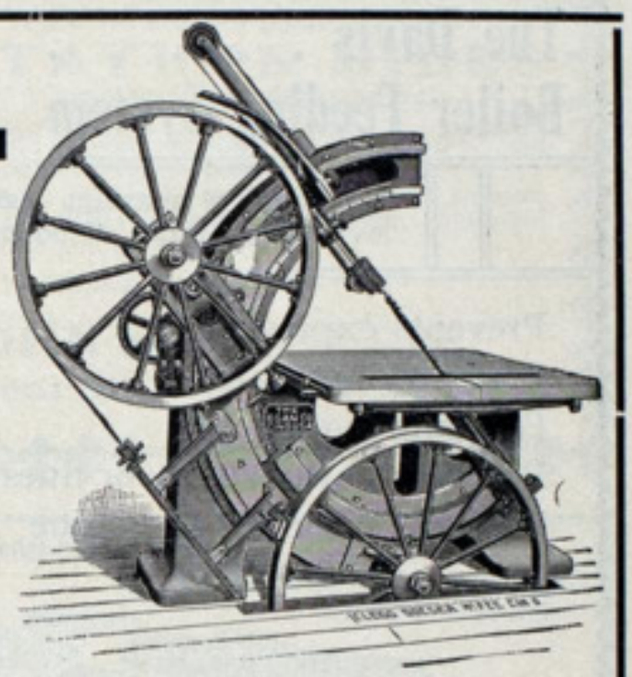

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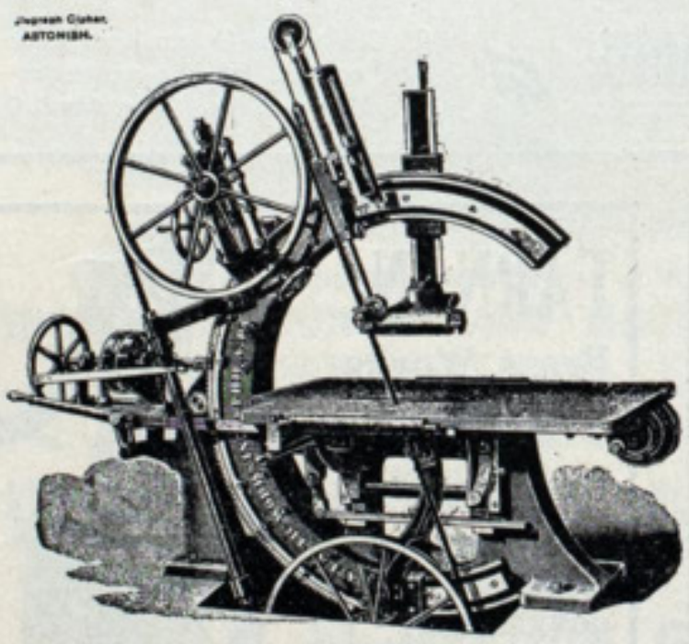

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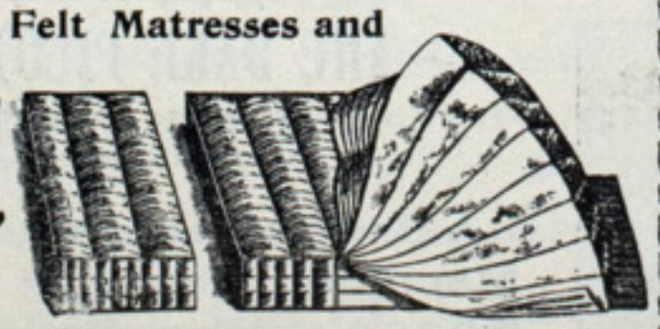

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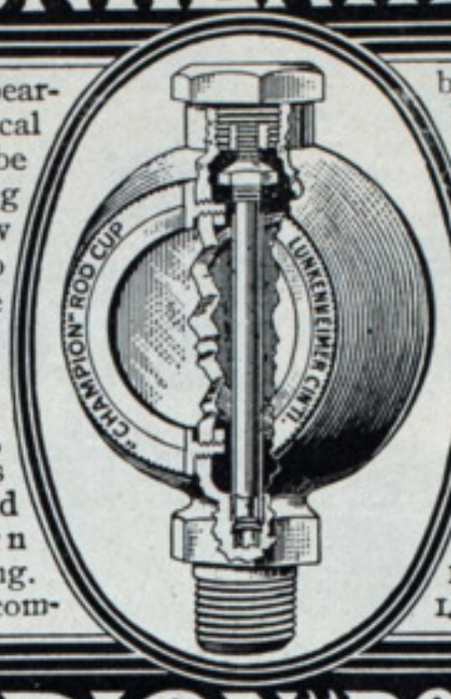

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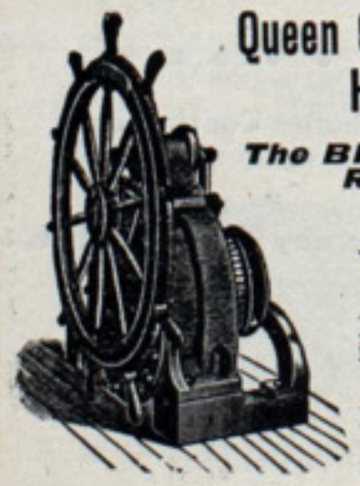

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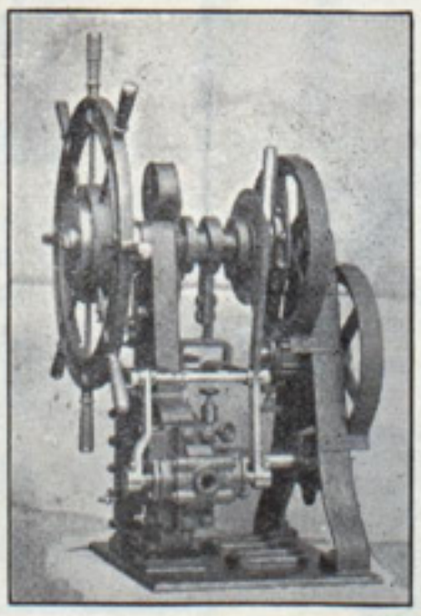

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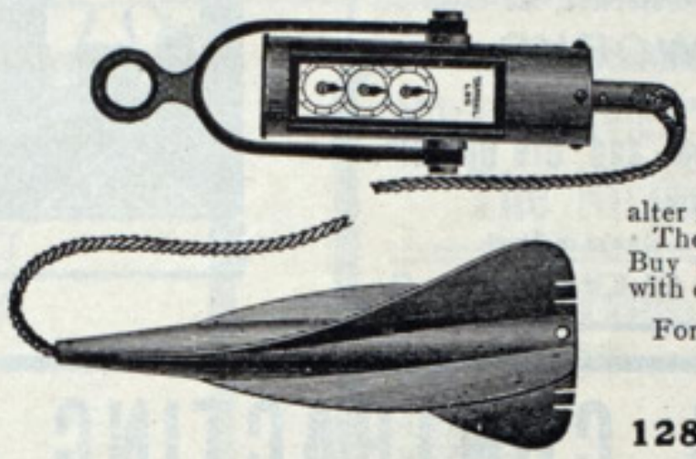

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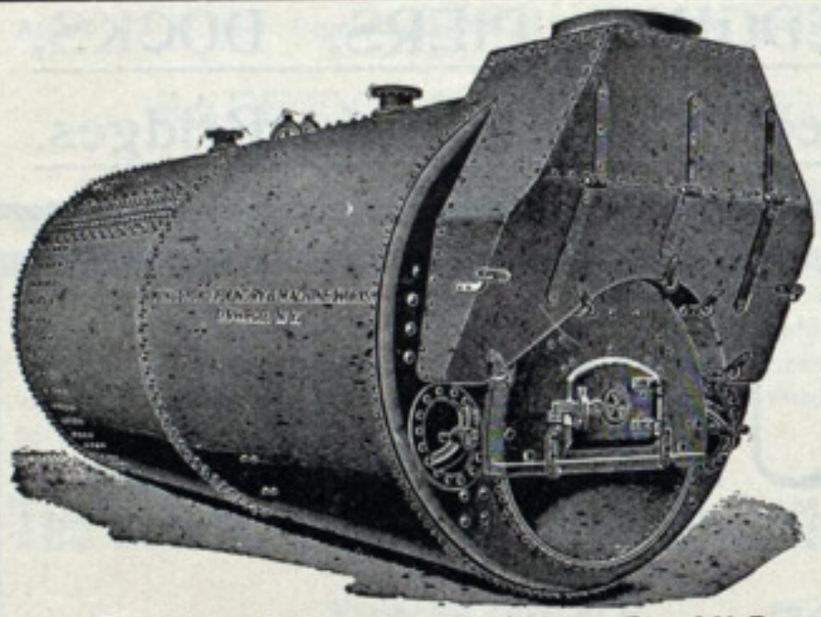

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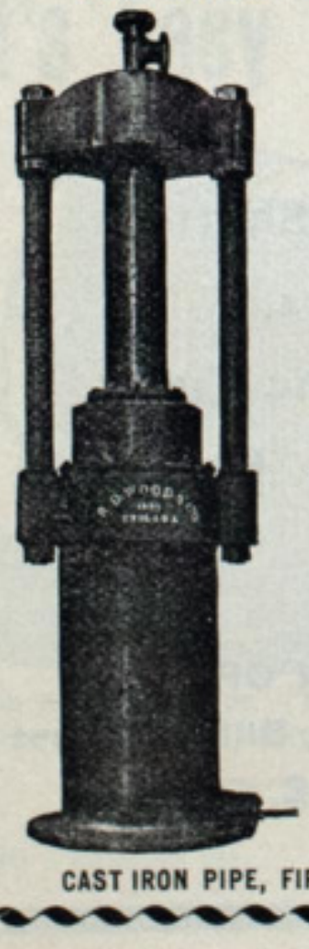

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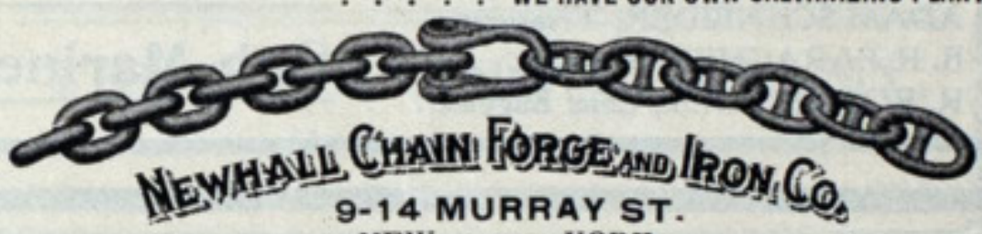

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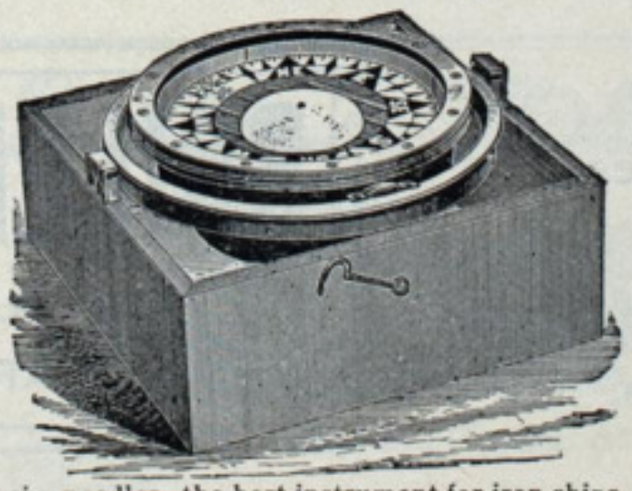

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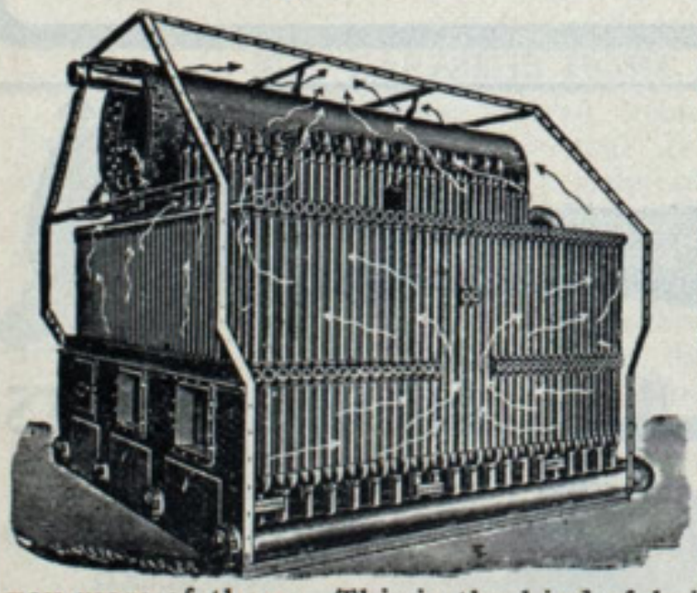

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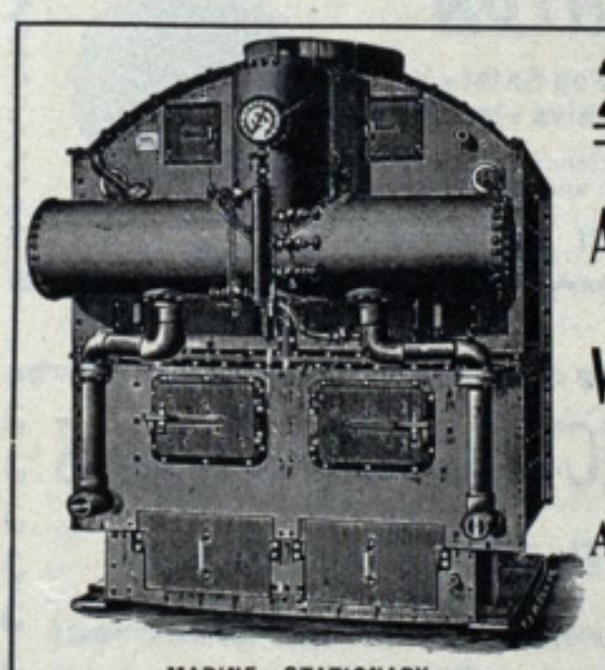

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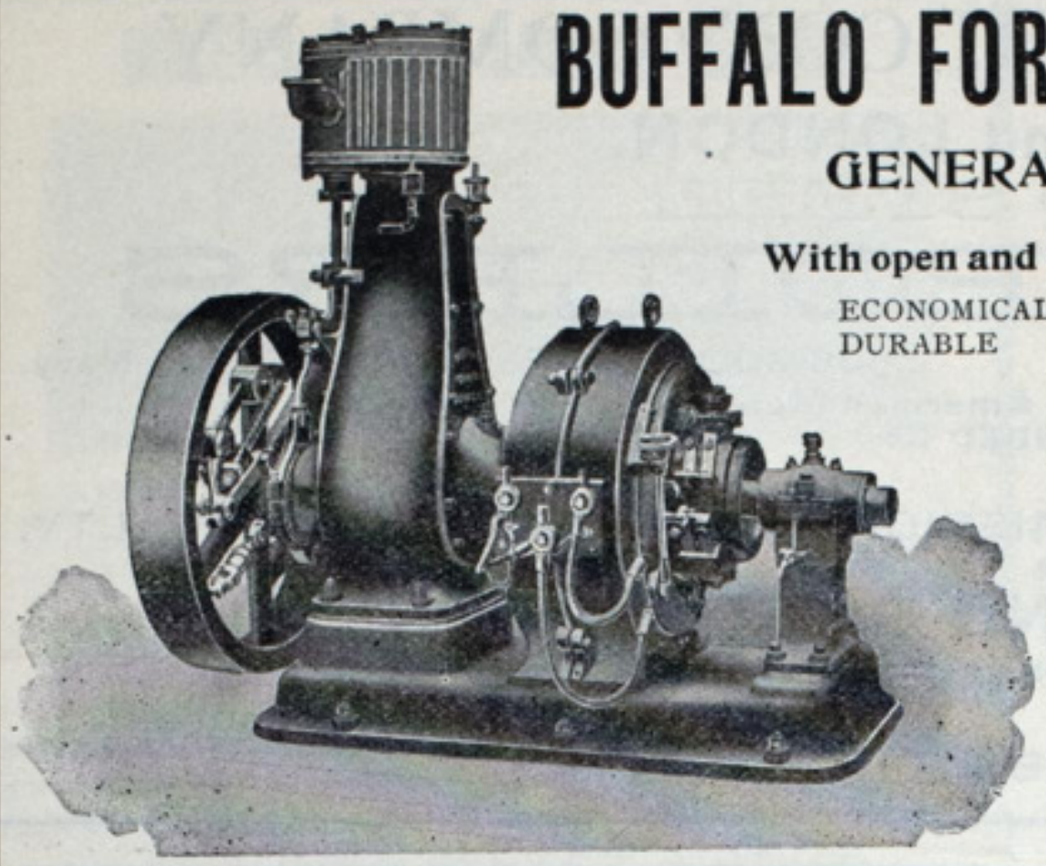

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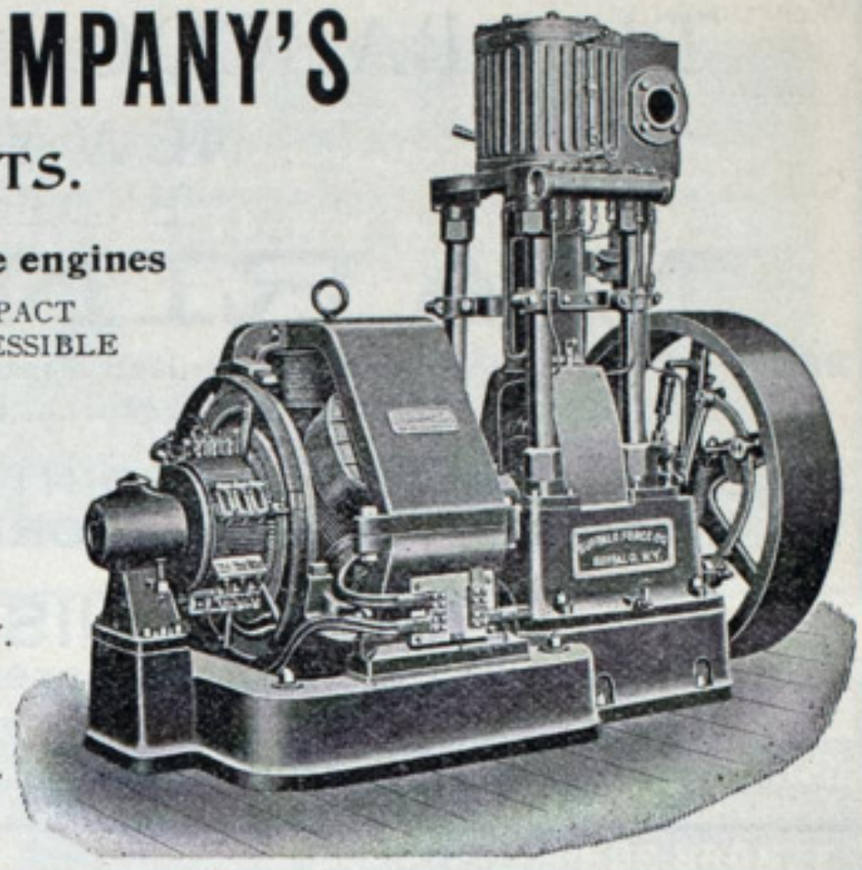

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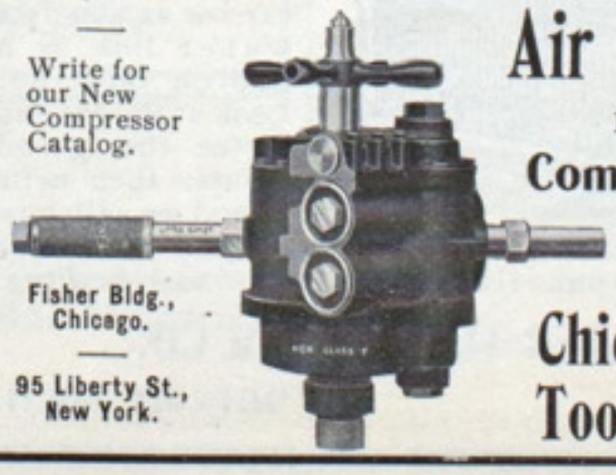

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